L Number	Hits	Search Text	DB	Time stamp
-	111	((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) same (mobile or portable) same (messag$3 or alert$3)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/06 10:34
-	158	((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) same (mobile or portable) same (messag$3 or alert$3 or commnicat$4 or signal$1) same information	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/06 10:35
-	30	((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) same (mobile or portable) same (messag$3 or alert$3 or commnicat$4 or signal$1) same information same wireless	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/06 11:19
-	30	(((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) same (mobile or portable) same (messag$3 or alert$3 or commnicat$4 or signal$1) same information same wireless) and ((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) and (mobile or portable) and (messag$3 or alert$3 or commnicat$4 or signal$1) and information and wireless	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/06 11:27
-	6	((((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) same (mobile or portable) same (messag$3 or alert$3 or commnicat$4 or signal$1) same information same wireless) and ((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) and (mobile or portable) and (messag$3 or alert$3 or commnicat$4 or signal$1) and information and wireless) and uniqu$3 and identif$5 and data and server$1 and transmit$4 and transceiv$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/06 11:59
-	19	((((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) same (mobile or portable) same (messag$3 or alert$3 or commnicat$4 or signal$1) same information same wireless) and ((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) and (mobile or portable) and (messag$3 or alert$3 or commnicat$4 or signal$1) and information and wireless) and uniqu$3 and identif$5 and data and server$1	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/06 11:59
-	8	((((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) same (mobile or portable) same (messag$3 or alert$3 or commnicat$4 or signal$1) same information same wireless) and ((barcod$3 or bar-cod$3 or (bar adj cod$3)) adj (terminal$1 or reader$1 or scan$3)) and (mobile or portable) and (messag$3 or alert$3 or commnicat$4 or signal$1) and information and wireless) and uniqu$3 and identif$5 and data and (server$1 or network$1) and transmit$4 and transceiv$4	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/06 12:09

US006493747B2

(12) **United States Patent**
Simmon et al.

(10) **Patent No.: US 6,493,747 B2**
(45) **Date of Patent: Dec. 10, 2002**

(54) **MULTI-TIER DATA ACQUISITION AND MANAGEMENT SYSTEM COMPRISING AT LEAST ONE TOUCH-SCREEN ENABLED PORTABLE COMPUTING DEVICE OPERABLY COUPLED TO COMPUTERS VIA WIRELESS COMMUNICATION FOR ACCESSING DATA RECORDS STORED IN LOCAL DATABASES COUPLED TO THE COMPUTERS**

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(73) Assignee: **Metrologic Instruments, Inc.**, Blackwood, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/823,326**

(22) Filed: **Mar. 30, 2001**

(65) **Prior Publication Data**

US 2002/0038378 A1 Mar. 28, 2002

Related U.S. Application Data

(63) Continuation of application No. 09/241,214, filed on Feb. 1, 1999, now Pat. No. 6,389,477, which is a continuation of application No. 08/196,452, filed on Feb. 14, 1994, now Pat. No. 5,867,688.

(51) **Int. Cl.**[7] **G06F 13/00**
(52) **U.S. Cl.** **709/208**
(58) **Field of Search** 709/200, 201, 709/208, 211, 212, 216, 217

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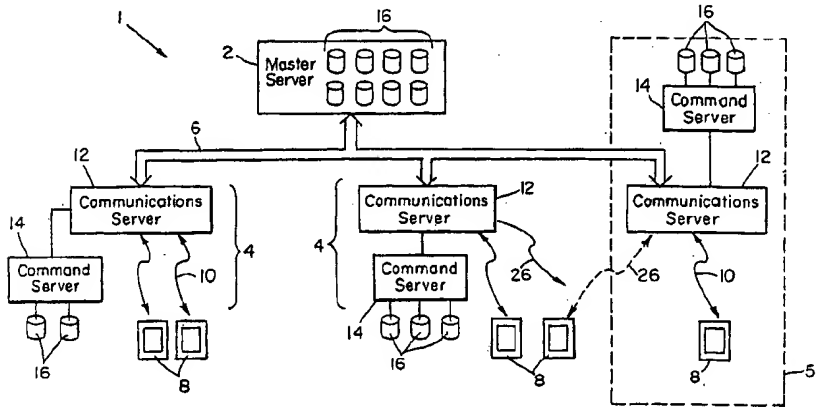
(List continued on next page.)

Primary Examiner—Robert B. Harrell
(74) *Attorney, Agent, or Firm*—Thomas J. Perkowski, Esq., P.C.

(57) **ABSTRACT**

A multi-tiered data acquisition and management system including at least two input computers, operably coupled via a communication link, each coupled to a respective local database of data records. The system includes at least two portable computing devices, each operably coupled to one of the two input computers via a wireless communication channel for accessing the data records of the local databases of the input computers. Each portable computing device comprises a CPU, memory, and a touch sensitive display device that cooperate to display multiple virtual regions (which comprise on a data I/O screen and sense location of contact by a user in these virtual regions to thereby provide for user input). These multiple virtual regions preferably include one of a virtual keypad for entering symbols associated with keys of the keypad, at least one scroll bar, at least one rolling key, multiple icons, a menu screen and a graphing screen. Each portable computer may have an integrated code reader (for example, bar code reader) for data entry. The information acquired and maintained by the system may include product information, information identifying a medical patient, or information related to a medical patient (such as personal information gathered upon admittance for care, information related to past medical history of the medical patient, and information related to vital statistics of the medical patient). In addition, each portable device may include a message notification mechanism that notifies the user of receipt of a message from one of the input computers over the respective wireless communication channels.

27 Claims, 17 Drawing Sheets



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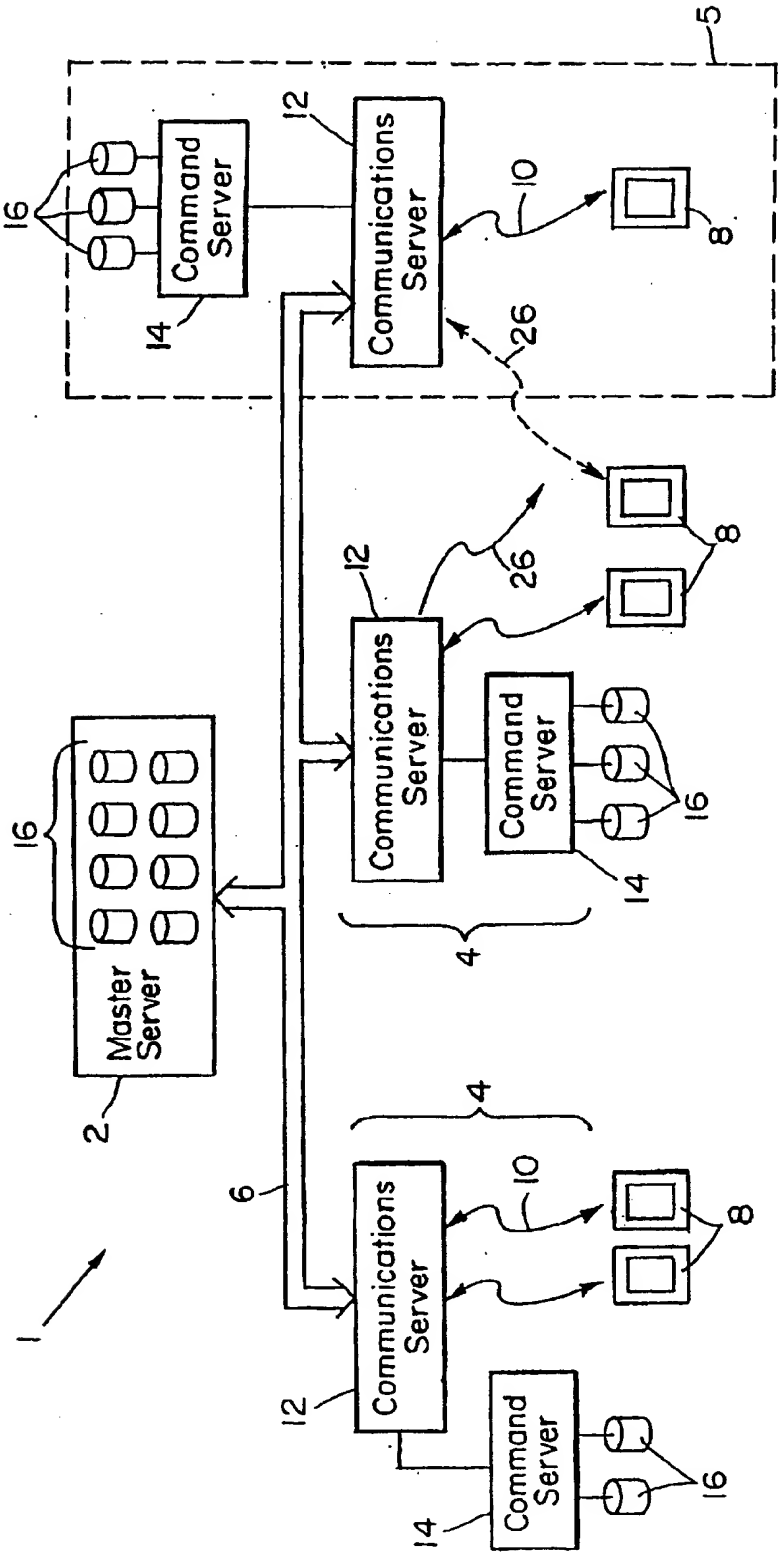
5
12
Communications Server
Command Server
16
14
10
8
26
Master Server
2
4
6
1

FIG. 1

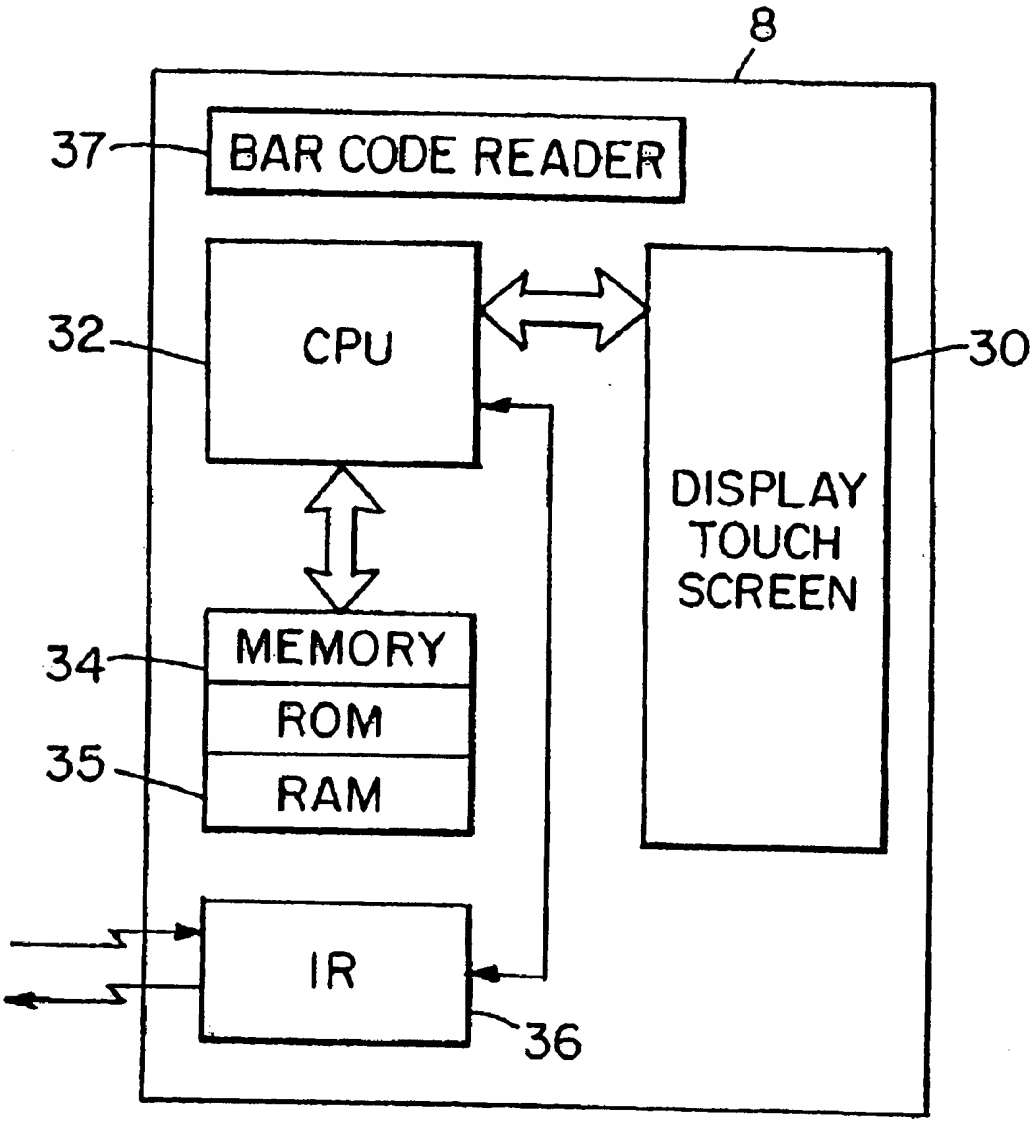
8
37
BAR CODE READER
32
CPU
30
DISPLAY
TOUCH
SCREEN
34
MEMORY
ROM
35
RAM
IR
36

FIG. 2

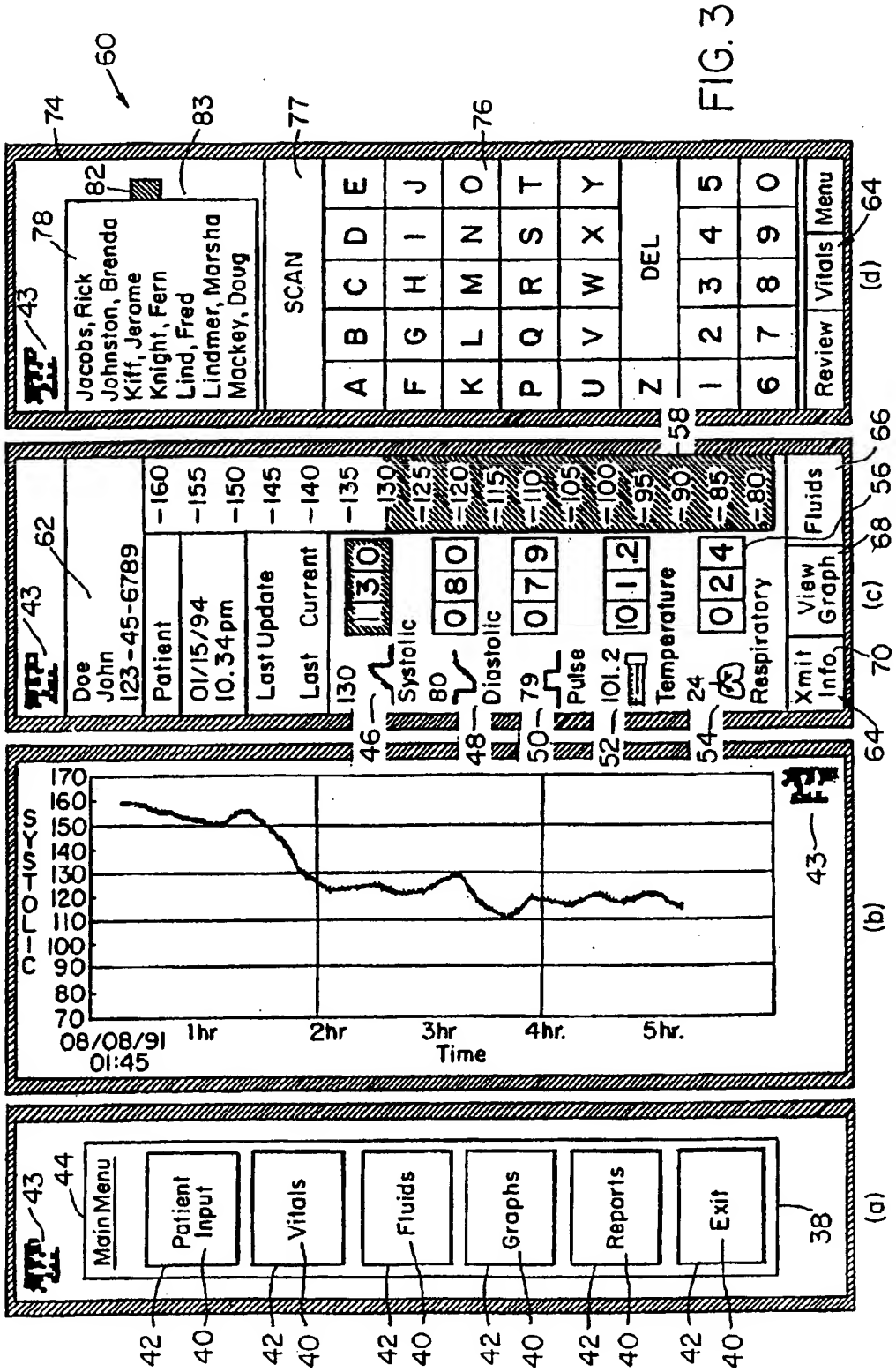
Main Menu
Patient Input
Vitals
Fluids
Graphs
Reports
Exit
(a)
(b)
(c)
(d)
Jacobs, Rick
Johnston, Brenda
Kiff, Jerome
Knight, Fern
Lind, Fred
Lindmer, Marsha
Mackey, Doug
SCAN
DEL
Review
Vitals
Menu
Doe
John
123-45-6789
Patient
01/15/94
10.34pm
Last Update
Last Current
Systolic
Diastolic
Pulse
Temperature
Respiratory
Xmit Info
View Graph
Fluids
08/08/91
01:45
1hr
2hr
3hr
4hr.
5hr.
Time

FIG. 3

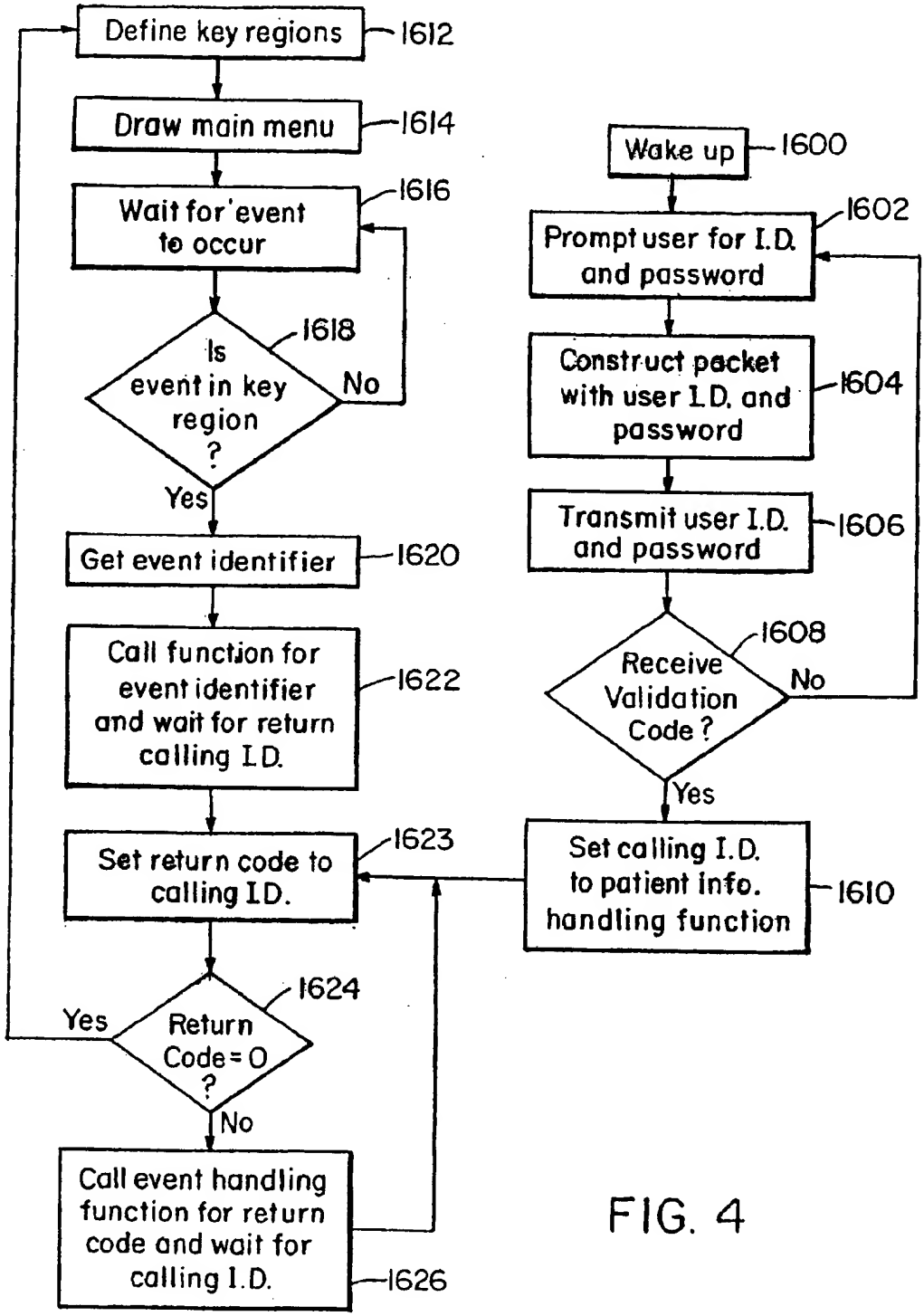
Define key regions
1612
Draw main menu
1614
Wait for event to occur
1616
Is event in key region ?
1618
No
Yes
Get event identifier
1620
Call function for event identifier and wait for return calling I.D.
1622
Set return code to calling I.D.
1623
Return Code = 0 ?
1624
Yes
No
Call event handling function for return code and wait for calling I.D.
1626
Wake up
1600
Prompt user for I.D. and password
1602
Construct packet with user I.D. and password
1604
Transmit user I.D. and password
1606
Receive Validation Code ?
1608
No
Yes
Set calling I.D. to patient info. handling function
1610

FIG. 4

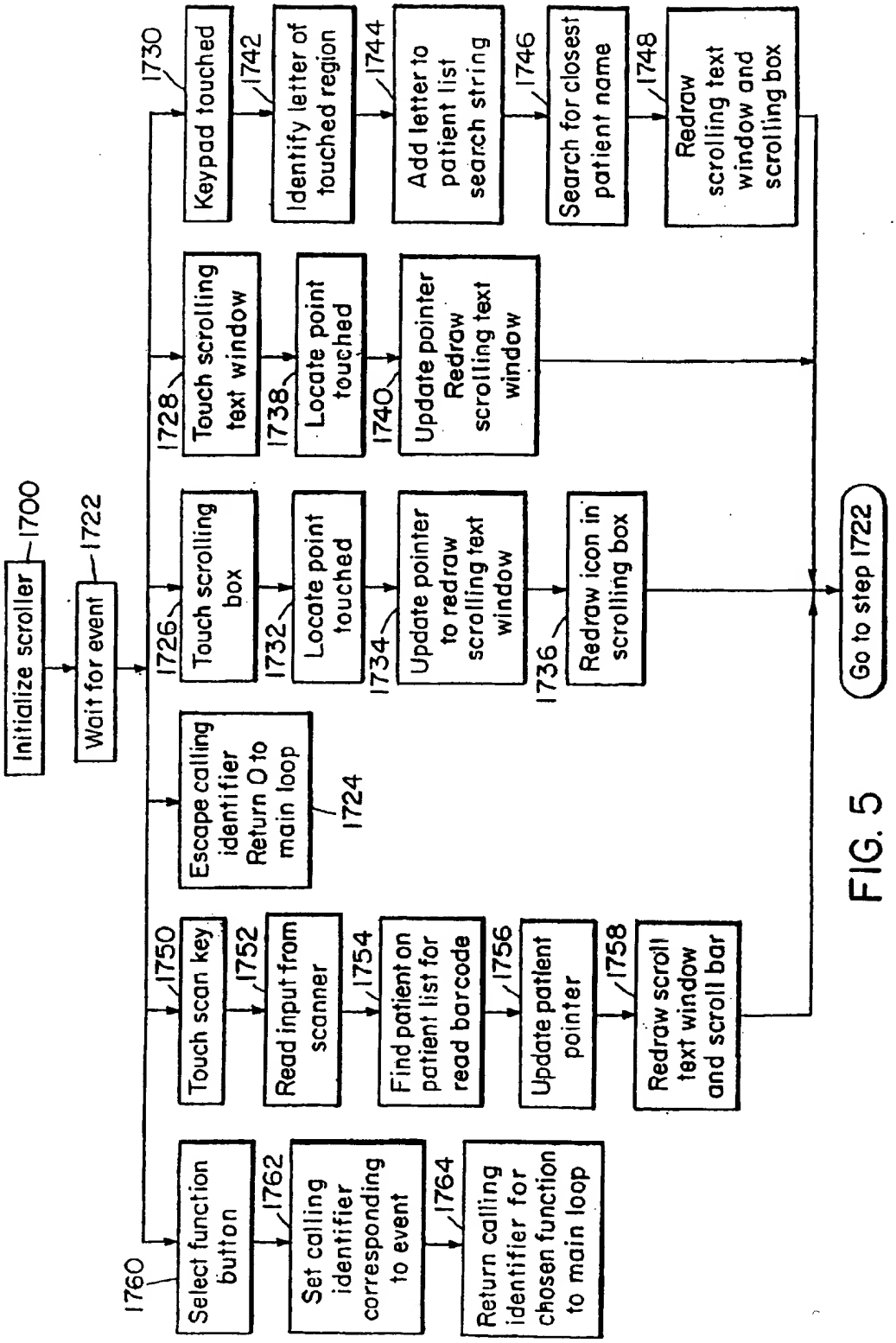
Initialize scroller
1700
Wait for event
1722
Escape calling identifier Return 0 to main loop
1724
Touch scrolling box
1726
Locate point touched
1732
Update pointer to redraw scrolling text window
1734
Redraw icon in scrolling box
1736
Touch scrolling text window
1728
Locate point touched
1738
Update pointer Redraw scrolling text window
1740
Keypad touched
1730
Identify letter of touched region
1742
Add letter to patient list search string
1744
Search for closest patient name
1746
Redraw scrolling text window and scrolling box
1748
Touch scan key
1750
Read input from scanner
1752
Find patient on patient list for read barcode
1754
Update patient pointer
1756
Redraw scroll text window and scroll bar
1758
Select function button
1760
Set calling identifier corresponding to event
1762
Return calling identifier for chosen function to main loop
1764
Go to step 1722

FIG. 5

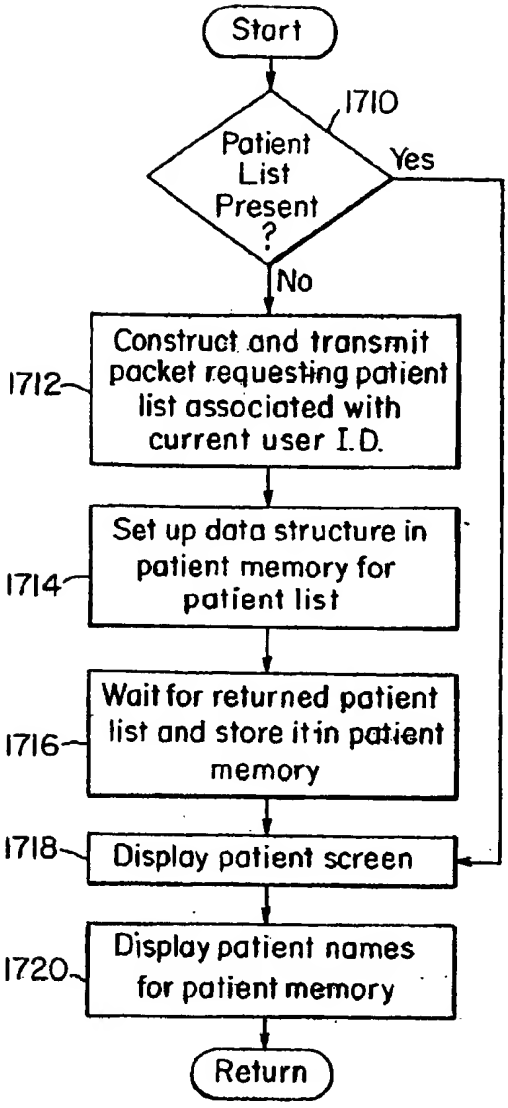
Start
1710
Patient List Present ?
Yes
No
1712
Construct and transmit packet requesting patient list associated with current user I.D.
1714
Set up data structure in patient memory for patient list
1716
Wait for returned patient list and store it in patient memory
1718
Display patient screen
1720
Display patient names for patient memory
Return

FIG. 6

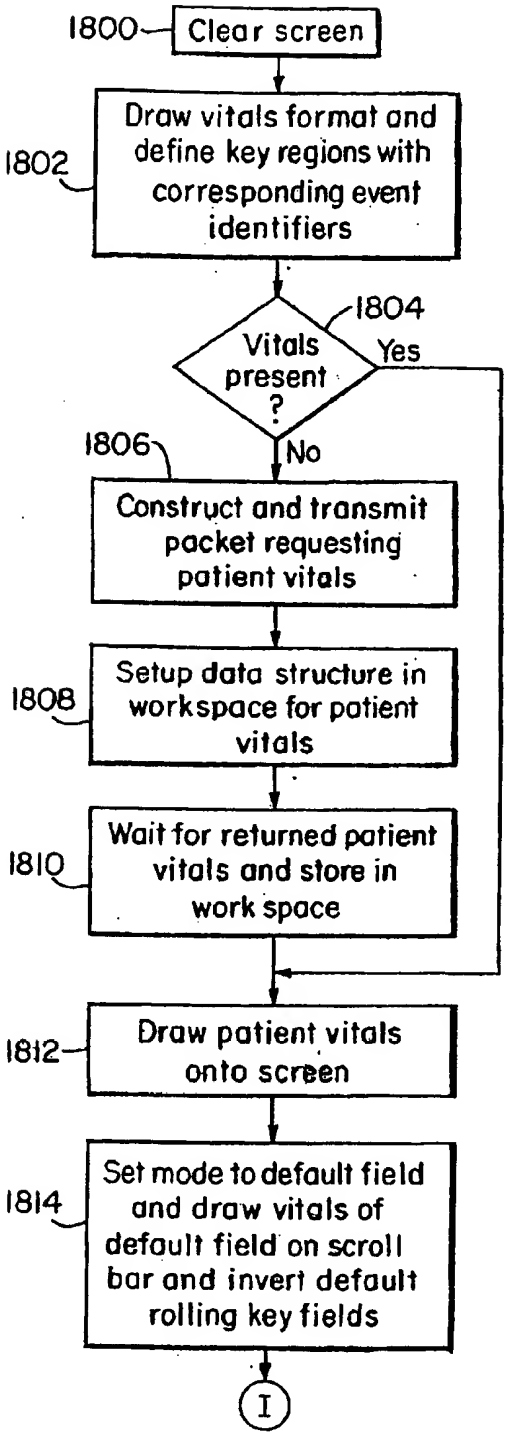
1800
Clear screen
1802
Draw vitals format and define key regions with corresponding event identifiers
1804
Vitals present ?
Yes
No
1806
Construct and transmit packet requesting patient vitals
1808
Setup data structure in workspace for patient vitals
1810
Wait for returned patient vitals and store in work space
1812
Draw patient vitals onto screen
1814
Set mode to default field and draw vitals of default field on scroll bar and invert default rolling key fields
I

FIG. 8

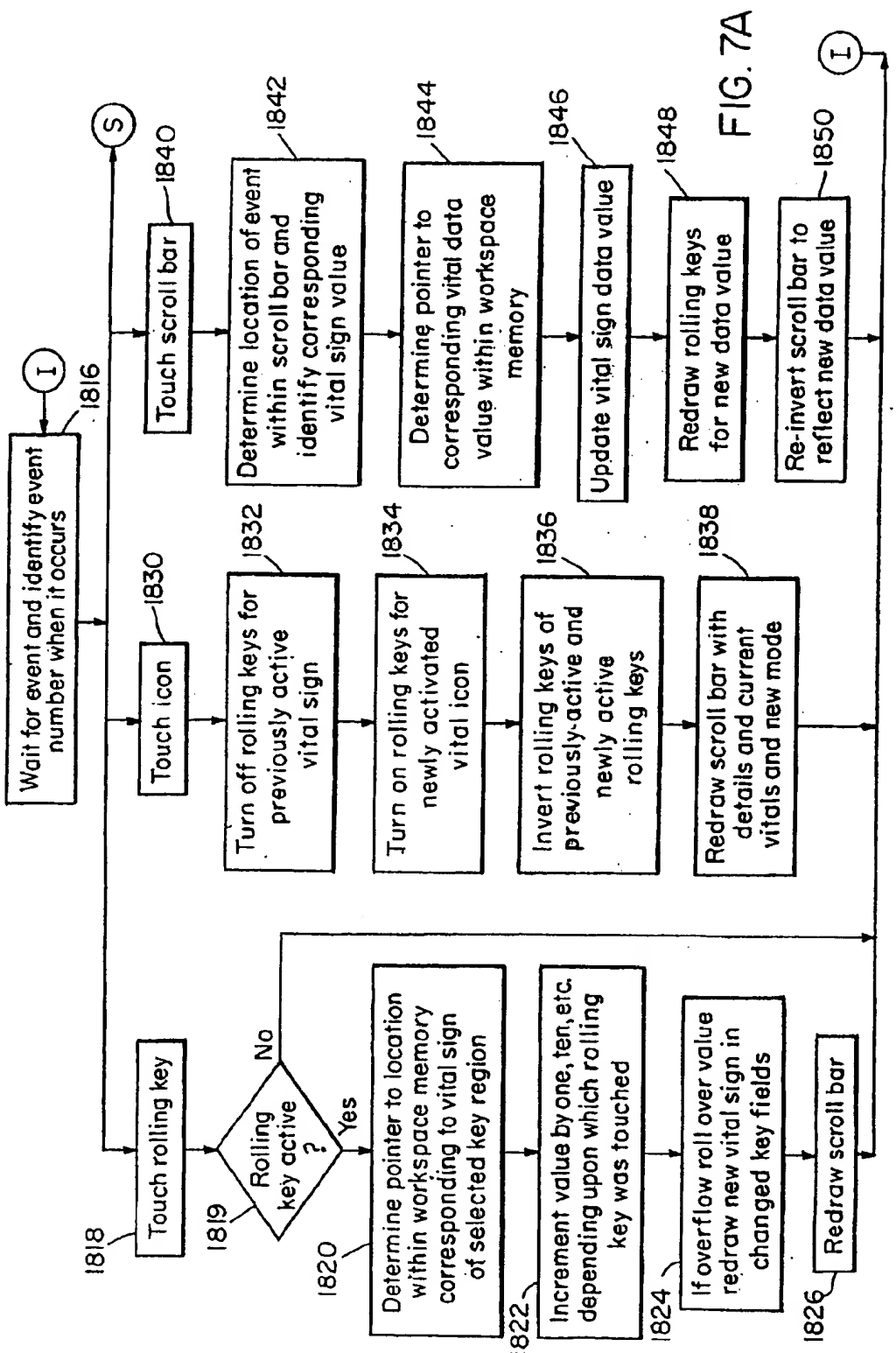
Wait for event and identify event number when it occurs
1816
I
S
Touch rolling key
1818
Rolling key active ?
1819
No
Yes
Determine pointer to location within workspace memory corresponding to vital sign of selected key region
1820
Increment value by one, ten, etc. depending upon which rolling key was touched
1822
If overflow roll over value redraw new vital sign in changed key fields
1824
Redraw scroll bar
1826
Touch icon
1830
Turn off rolling keys for previously active vital sign
1832
Turn on rolling keys for newly activated vital icon
1834
Invert rolling keys of previously-active and newly active rolling keys
1836
Redraw scroll bar with details and current vitals and new mode
1838
Touch scroll bar
1840
Determine location of event within scroll bar and identify corresponding vital sign value
1842
Determine pointer to corresponding vital data value within workspace memory
1844
Update vital sign data value
1846
Redraw rolling keys for new data value
1848
Re-invert scroll bar to reflect new data value
1850
I

FIG. 7A

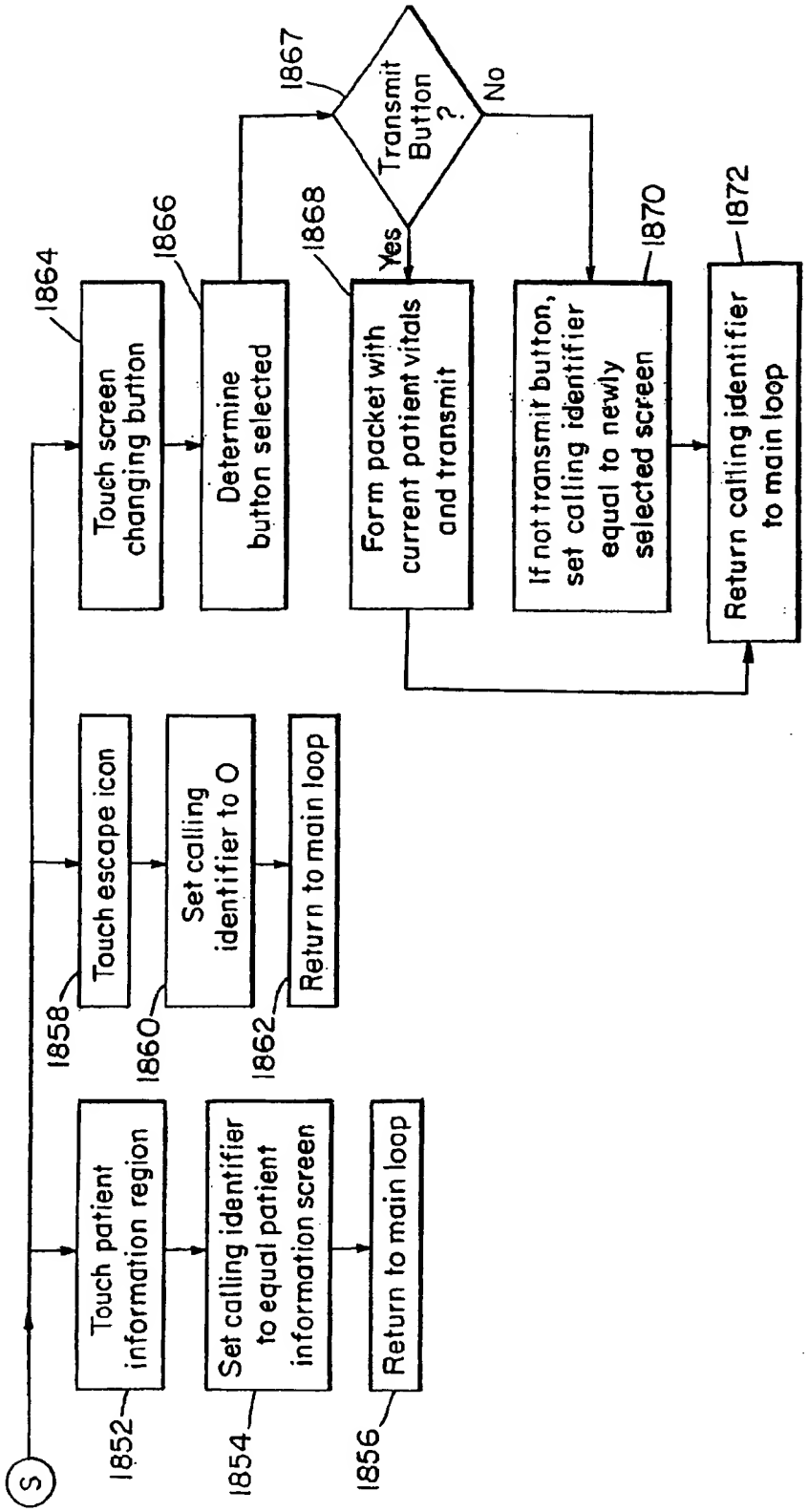
S
Touch patient information region
1852
Set calling identifier to equal patient information screen
1854
Return to main loop
1856
Touch escape icon
1858
Set calling identifier to 0
1860
Return to main loop
1862
Touch screen changing button
1864
Determine button selected
1866
Transmit Button ?
1867
Yes
No
Form packet with current patient vitals and transmit
1868
If not transmit button, set calling identifier equal to newly selected screen
1870
Return calling identifier to main loop
1872

FIG. 7B

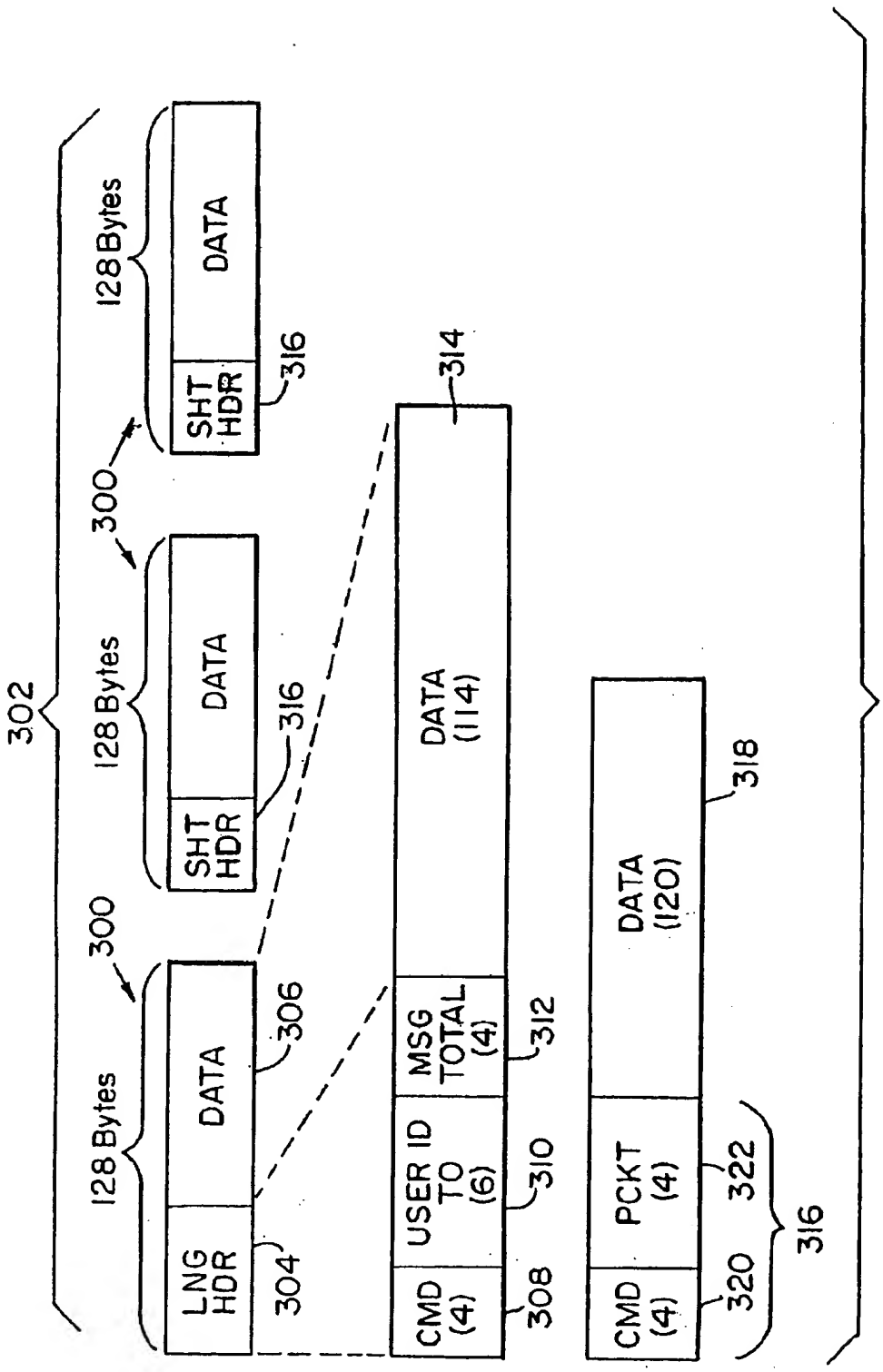
302
300
128 Bytes
LNG HDR
DATA
304
306
300
128 Bytes
SHT HDR
DATA
316
300
128 Bytes
SHT HDR
DATA
316
CMD (4)
USER ID TO (6)
MSG TOTAL (4)
DATA (114)
308
310
312
314
CMD (4)
PCKT (4)
DATA (120)
320
322
318
316

FIG. 9

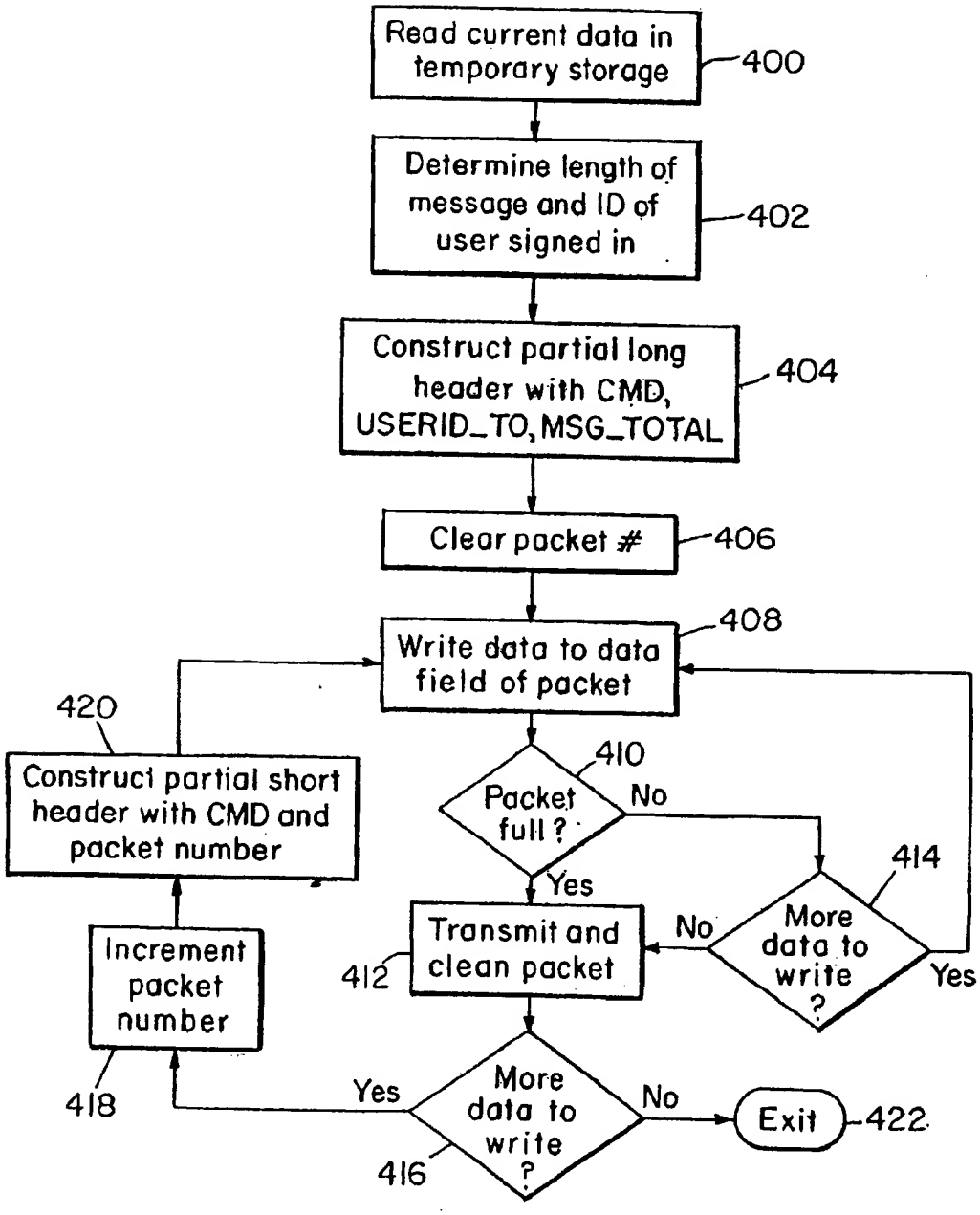
Read current data in temporary storage
400
Determine length of message and ID of user signed in
402
Construct partial long header with CMD, USERID_TO, MSG_TOTAL
404
Clear packet #
406
Write data to data field of packet
408
Packet full ?
410
No
Yes
Transmit and clean packet
412
More data to write ?
414
No
Yes
Construct partial short header with CMD and packet number
420
Increment packet number
418
More data to write ?
416
Yes
No
Exit
422

FIG. 10

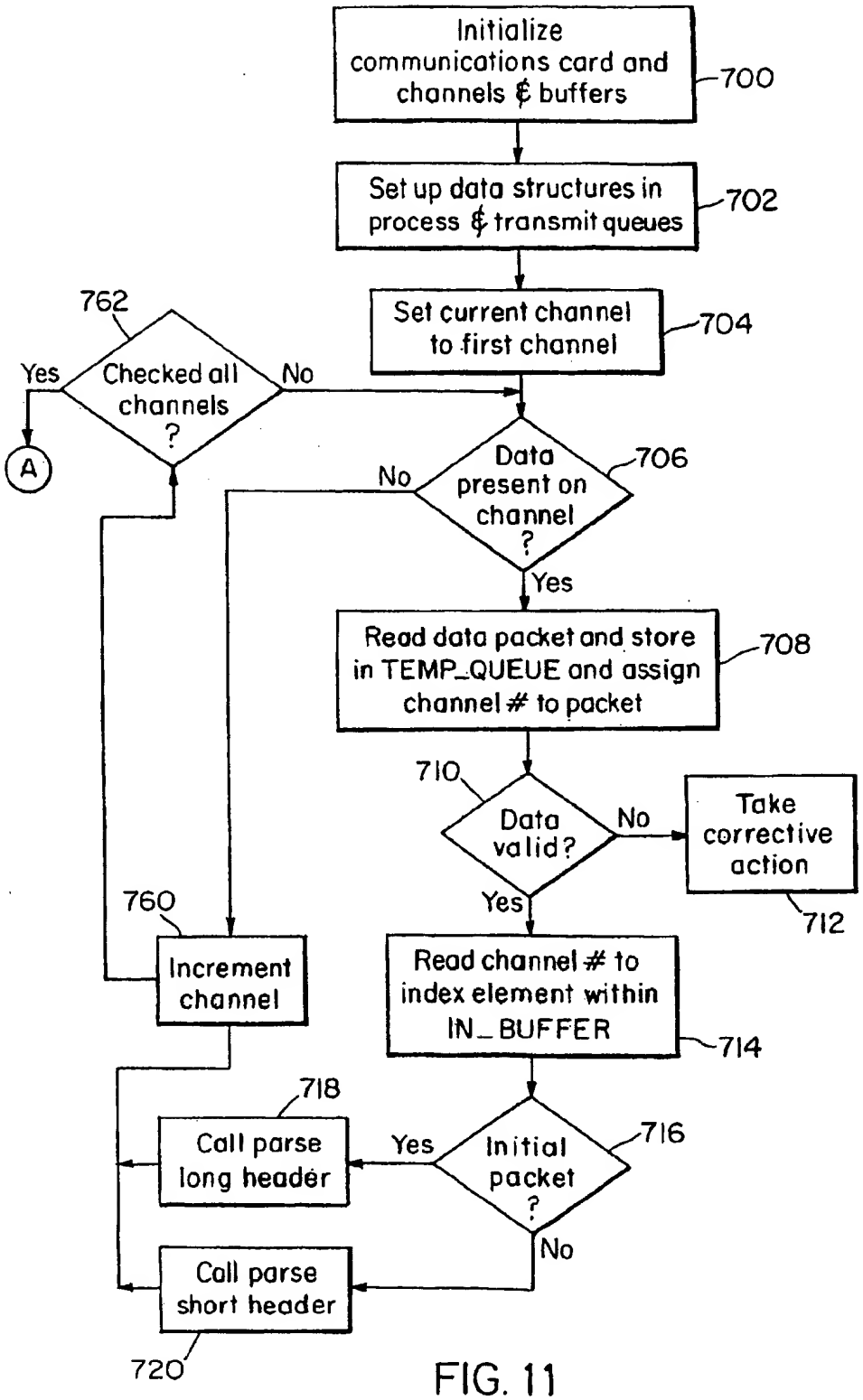
Initialize communications card and channels & buffers
700
Set up data structures in process & transmit queues
702
Set current channel to first channel
704
762
Checked all channels ?
Yes
No
A
Data present on channel ?
706
No
Yes
Read data packet and store in TEMP_QUEUE and assign channel # to packet
708
710
Data valid?
No
Take corrective action
712
Yes
760
Increment channel
Read channel # to index element within IN_BUFFER
714
718
Call parse long header
Yes
Initial packet ?
716
No
Call parse short header
720

FIG. 11

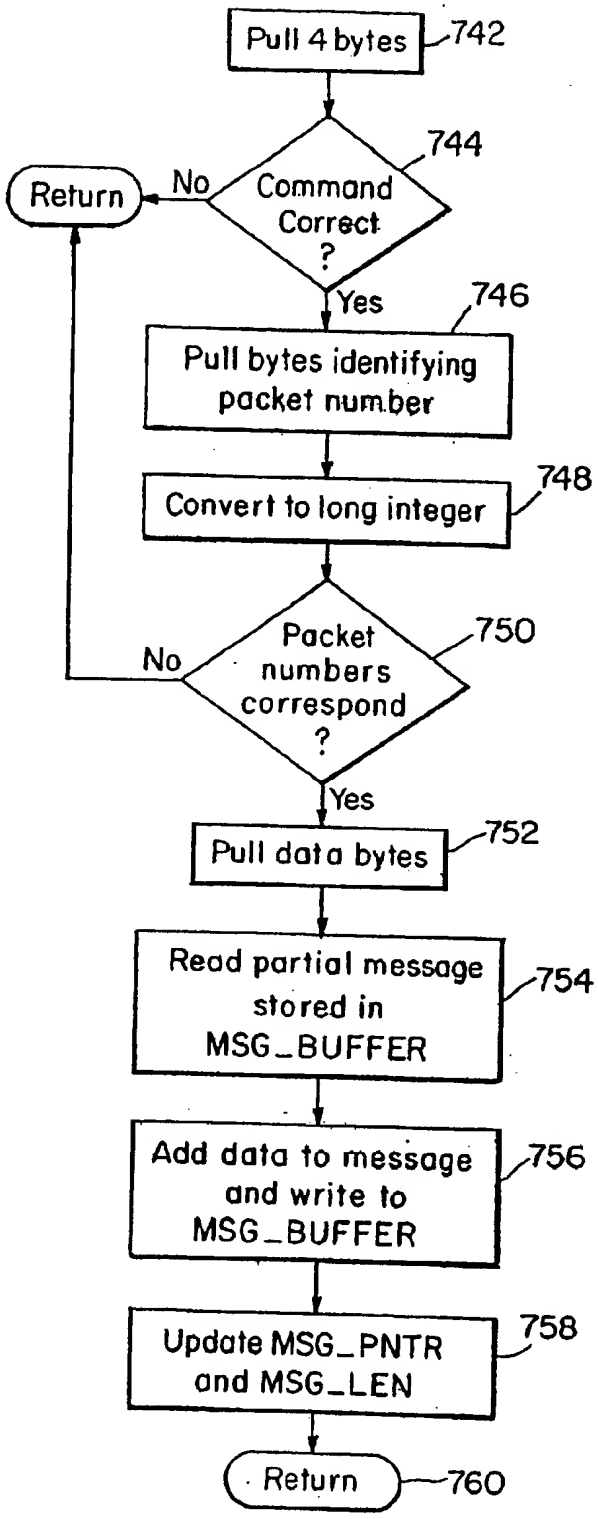
Pull 4 bytes
742
744
Command Correct ?
No
Return
Yes
746
Pull bytes identifying packet number
748
Convert to long integer
750
Packet numbers correspond ?
No
Yes
752
Pull data bytes
754
Read partial message stored in MSG_BUFFER
756
Add data to message and write to MSG_BUFFER
758
Update MSG_PNTR and MSG_LEN
Return
760

FIG. 12

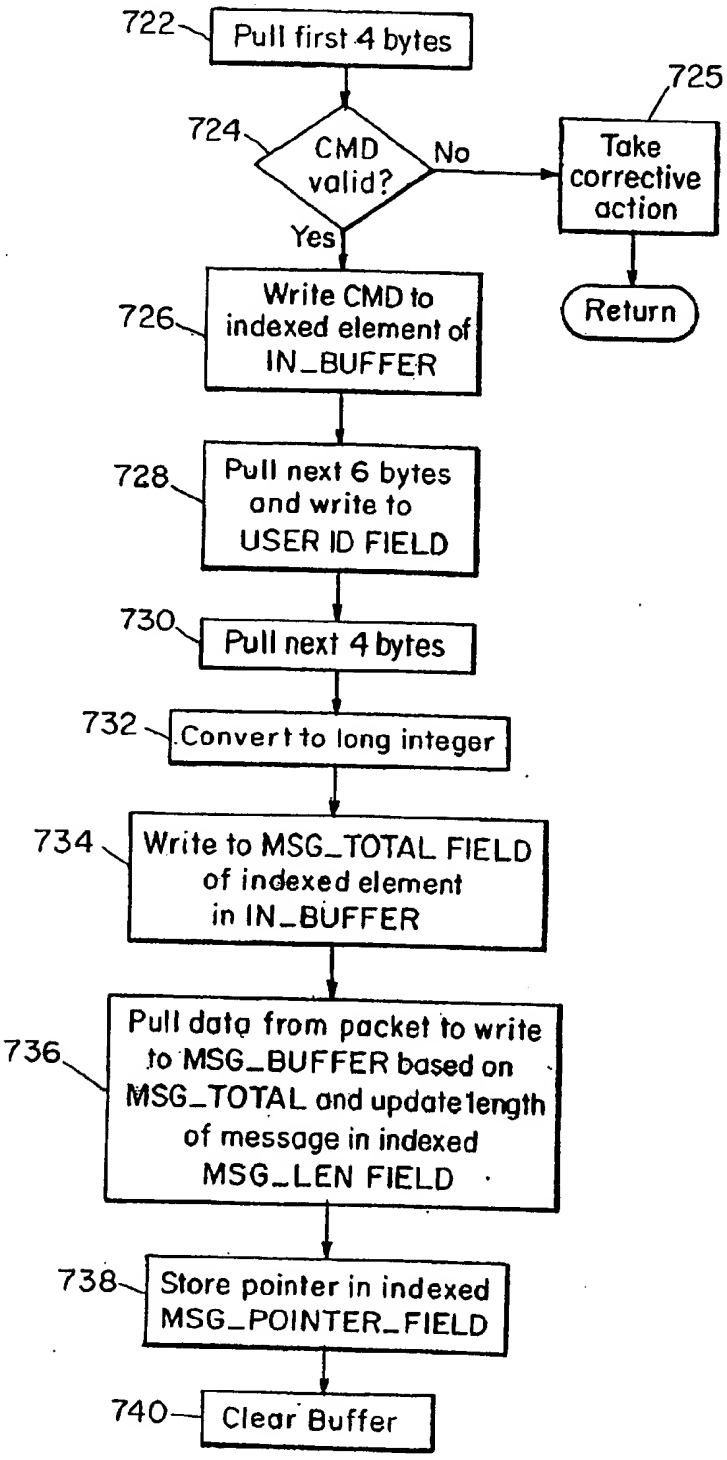
722
Pull first 4 bytes
724
CMD valid?
No
725
Take corrective action
Return
Yes
726
Write CMD to indexed element of IN_BUFFER
728
Pull next 6 bytes and write to USER ID FIELD
730
Pull next 4 bytes
732
Convert to long integer
734
Write to MSG_TOTAL FIELD of indexed element in IN_BUFFER
736
Pull data from packet to write to MSG_BUFFER based on MSG_TOTAL and update length of message in indexed MSG_LEN FIELD
738
Store pointer in indexed MSG_POINTER_FIELD
740
Clear Buffer

FIG. 13

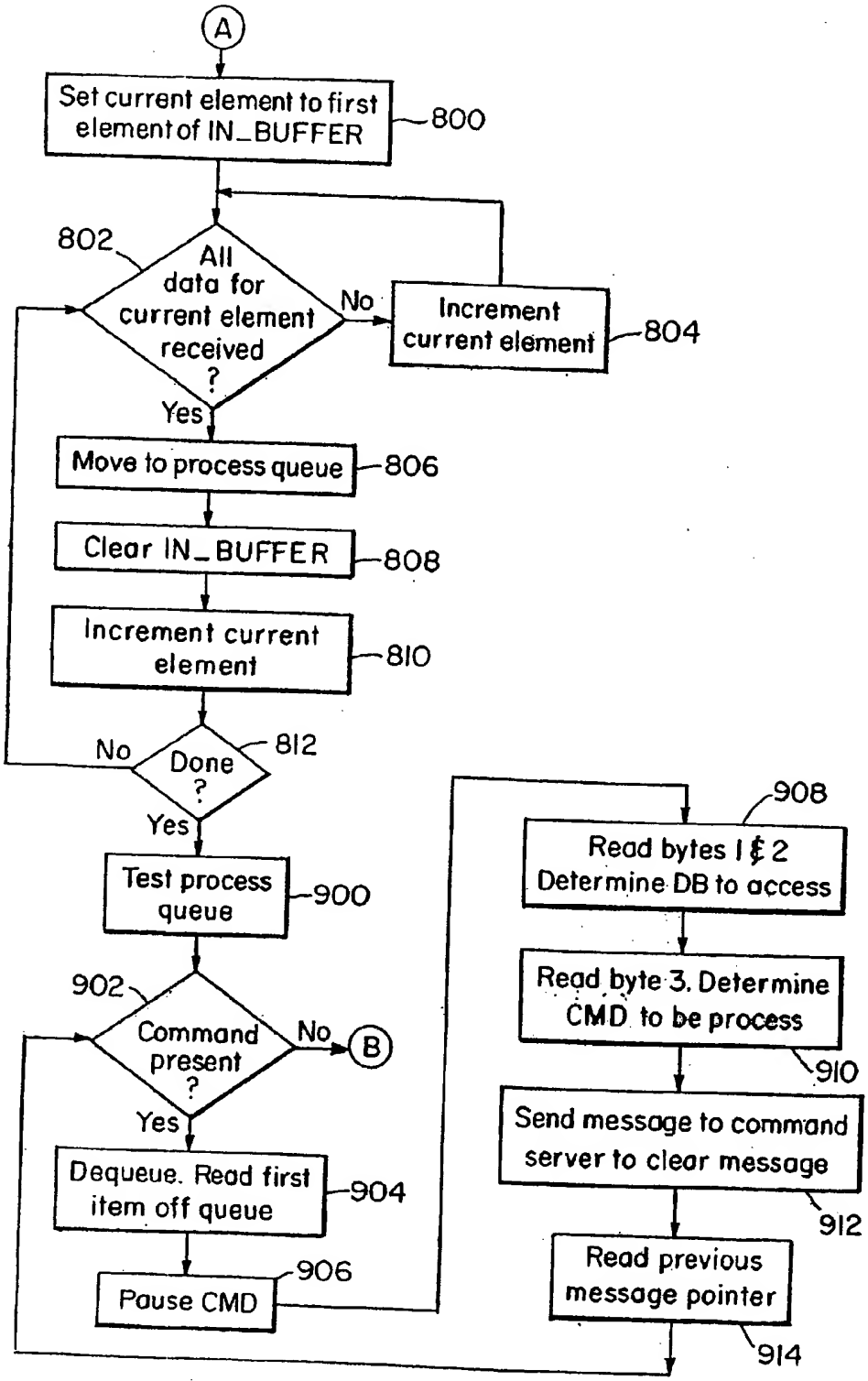
A
Set current element to first element of IN_BUFFER
800
802
All data for current element received ?
No
Increment current element
804
Yes
Move to process queue
806
Clear IN_BUFFER
808
Increment current element
810
No
Done ?
812
Yes
Test process queue
900
902
Command present ?
No
B
Yes
Dequeue. Read first item off queue
904
Pause CMD
906
908
Read bytes 1 & 2 Determine DB to access
Read byte 3. Determine CMD to be process
910
Send message to command server to clear message
912
Read previous message pointer
914

FIG. 14

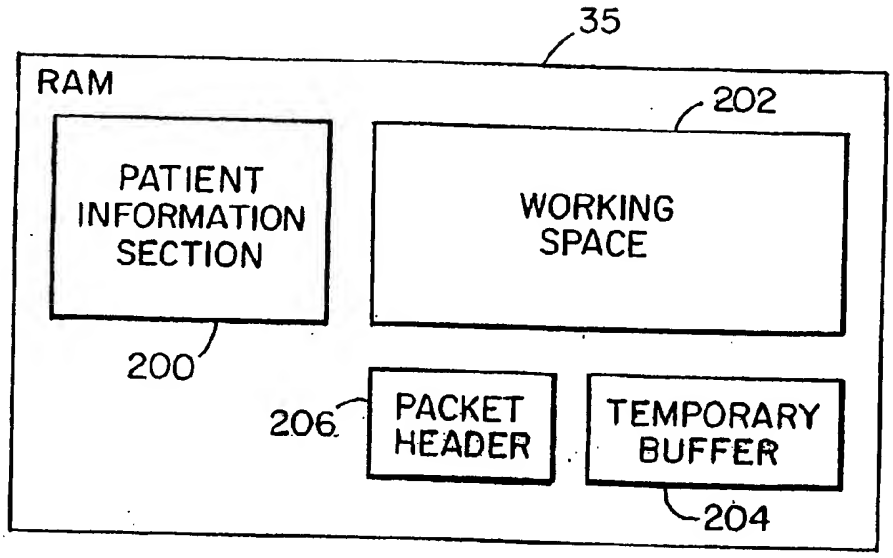
35
RAM
202
PATIENT INFORMATION SECTION
WORKING SPACE
200
206
PACKET HEADER
TEMPORARY BUFFER
204

FIG. 15

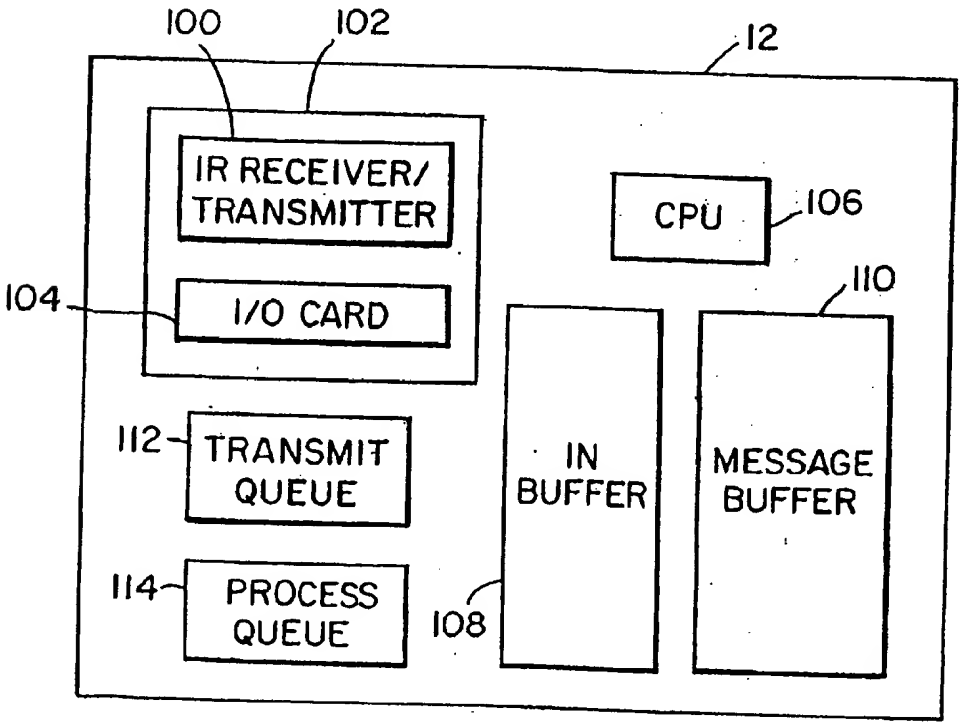
100
102
12
IR RECEIVER/ TRANSMITTER
CPU
106
104
I/O CARD
110
112
TRANSMIT QUEUE
IN BUFFER
MESSAGE BUFFER
114
PROCESS QUEUE
108

FIG. 16

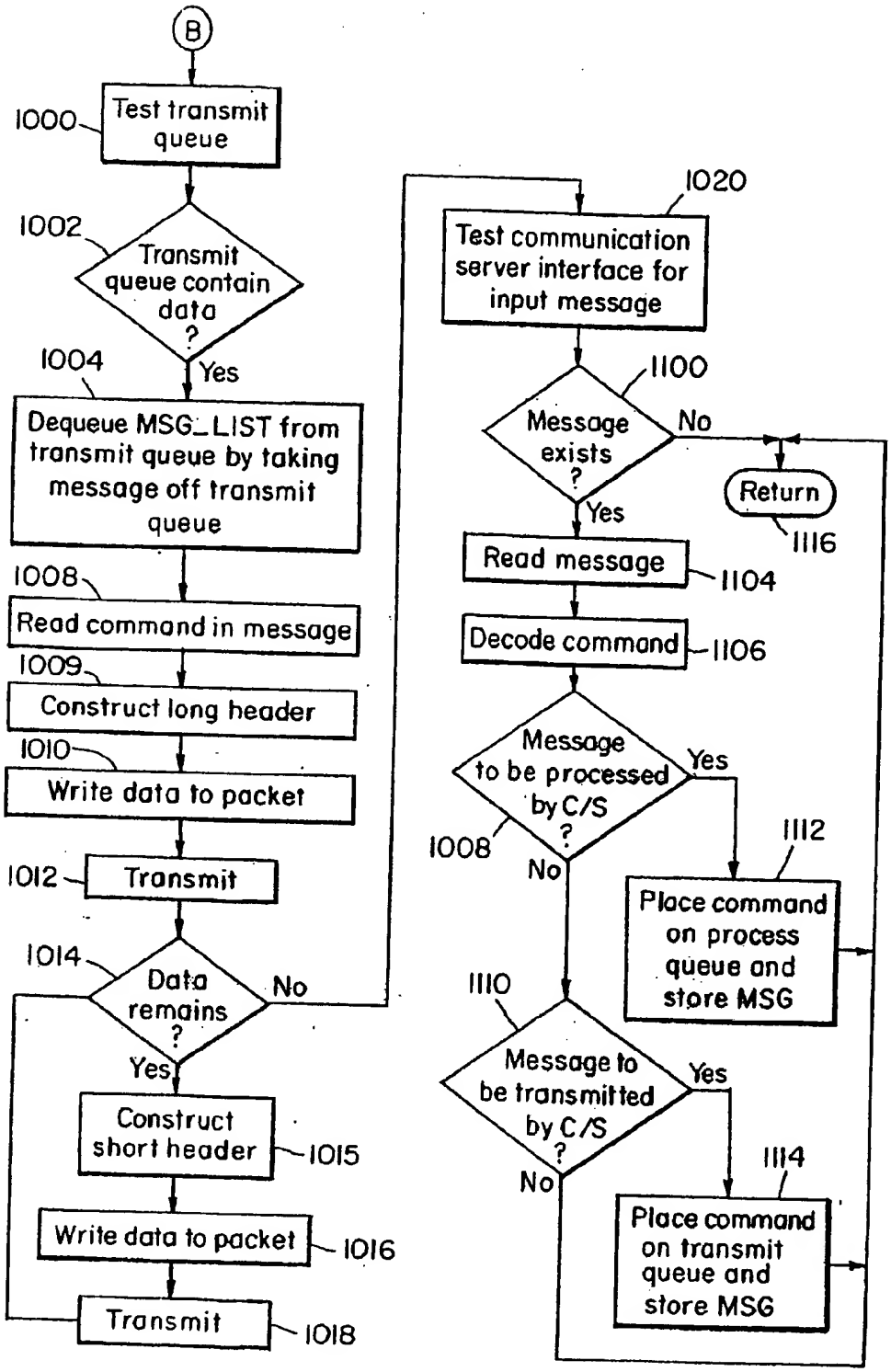
B
1000
Test transmit queue
1002
Transmit queue contain data ?
Yes
1004
Dequeue MSG_LIST from transmit queue by taking message off transmit queue
1008
Read command in message
1009
Construct long header
1010
Write data to packet
1012
Transmit
1014
Data remains ?
No
Yes
Construct short header
1015
Write data to packet
1016
Transmit
1018
1020
Test communication server interface for input message
1100
Message exists ?
No
Return
1116
Yes
Read message
1104
Decode command
1106
Message to be processed by C/S ?
Yes
1008
No
1112
Place command on process queue and store MSG
1110
Message to be transmitted by C/S ?
Yes
No
1114
Place command on transmit queue and store MSG

FIG. 17

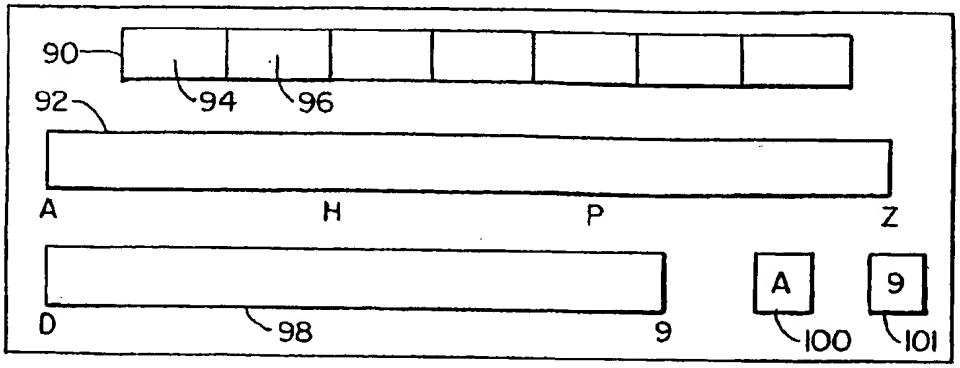
90
94
96
92
A
H
P
Z
D
98
9
A
9
100
101

FIG. 18

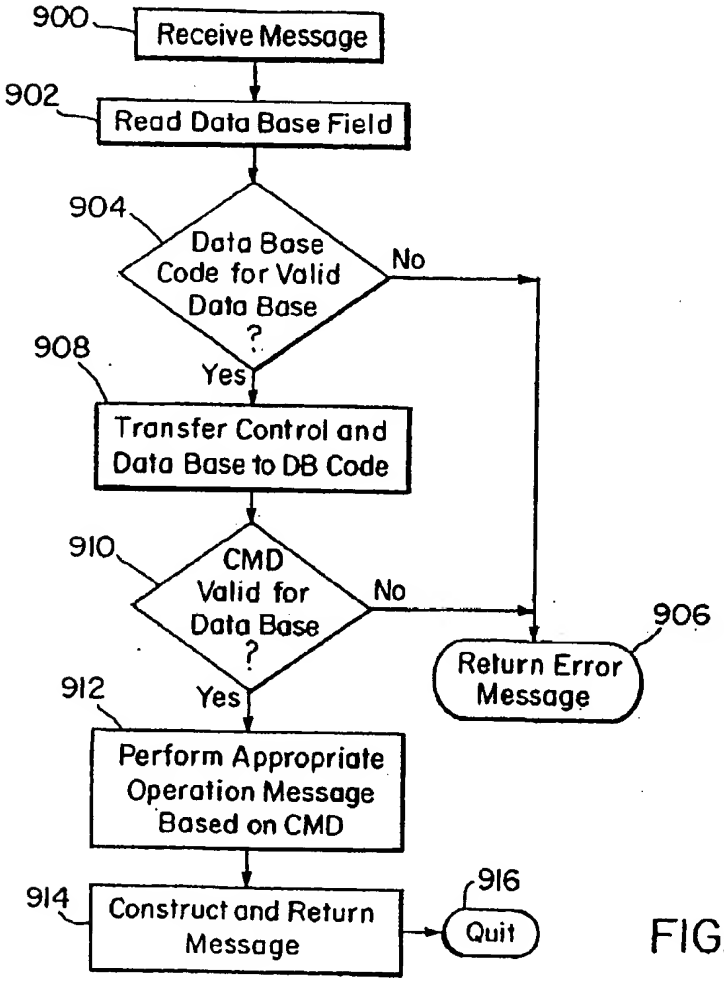
900
Receive Message
902
Read Data Base Field
904
Data Base Code for Valid Data Base ?
No
Yes
908
Transfer Control and Data Base to DB Code
910
CMD Valid for Data Base ?
No
Yes
906
Return Error Message
912
Perform Appropriate Operation Message Based on CMD
914
Construct and Return Message
916
Quit

FIG. 19

MULTI-TIER DATA ACQUISITION AND MANAGEMENT SYSTEM COMPRISING AT LEAST ONE TOUCH-SCREEN ENABLED PORTABLE COMPUTING DEVICE OPERABLY COUPLED TO COMPUTERS VIA WIRELESS COMMUNICATION FOR ACCESSING DATA RECORDS STORED IN LOCAL DATABASES COUPLED TO THE COMPUTERS

RELATED CASES

This Application is a Continuation of U.S. application Ser. No. 09/241,214 filed Feb. 1, 1999, now U.S. Pat. No. 6,389,477; which is a Continuation of U.S. application Ser. No. 08/196,452 filed Feb. 14, 1994, now U.S. Pat. No. 5,867,688. Each said patent application is assigned to and commonly owned by Metrologic Instruments, Inc. of Blackwood, N.J., and is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to a system for data acquisition and retrieval through the use of a user interface remotely located from the control system.

2. Description of the Related Art

Today, most commercial businesses require field employees, such as at points of sale, to fill out paper forms with data sets concerning individual customers or products sold/manufactured. These reports are then collected, compiled and assimilated at a central location and filed for future access. Most modern businesses require this information to be continuously updated and that the field personnel be afforded quick access thereto in order to reduce business costs, improve efficiency, increase accuracy, and the like. Heretofore, data sets concerning matters, such as customer or product information, have been primarily compiled through paper forms completed by field personnel and later possibly entered into some form of central database.

In the healthcare field, hospitals utilize a significant amount of data retrieval and acquisition, with respect to patient information. All data sets containing patient information (data field), such as patient name (a data set, header), date of birth, place of business, address, phone numbers, language, billing account number, social security number, drivers license number, and the like were written on paper forms and maintained in a paper file, and optionally entered by the hospital staff into a common database. Thereafter, the patient information was supplemented with information pertaining to their health condition, such as vital signs, fluid intake, fluid output and the like, which were written on different paper forms by a nurse and later keyed into this common database. Similarly, when patients undergo testing, the test results were manually keyed into the common database and/or written on forms stored in the patient's paper file.

An alternative example lies in the insurance industry in which field claims adjustors travel to the site of an insurance claim and evaluate the damaged property. These adjustors fill out multiple forms identifying the damage and the insured person's general information. For instance, in an automotive accident the claims adjustor must describe each problem with the insured car, such as dents, scratches, and the like. These forms are later processed manually or keyed into a common database, after which, the claimant ultimately is paid.

A substantial amount of data acquisition and retrieval is also utilized in factory environments. During the course of manufacturing various products, floor workers and quality review must complete multiple forms concerning a given production unit.

However, every business requiring significant amounts of data acquisition and retrieval in its day-to-day business encounter similar problems. First and foremost, a significant amount of the field operative's time is required in filling out the corresponding paperwork, in which the potential for user error exists. Also, in systems using paper forms, the information must be ultimately transferred to an electronic database, which provides a second opportunity for user error. Clearly, it would be advantageous to reduce the number of user entries, thereby reducing the likelihood of error.

Further, in many markets, field personnel at one location typically require information quickly from another field location. For instance, in a hospital environment, a doctor within the general ward may require immediate information concerning a patient from the radiology department. However, the process under which the information is written down and carried between departments is very slow. Similarly, doctors and nurses require immediate and accurate knowledge of specific procedures to be followed with regard to particular patients. Past systems for maintaining individual patient procedures have proven ineffective.

Moreover, one office within a business will typically require information from another office which must be hand carried or which is unavailable after the closing hours of the second office. For instance, hospitals require lab testing results be hand-carried to doctors who may be waiting for such results during the course of surgery. Also, typically doctors require clinical data after the clinics have closed.

The need remains in this field for an improved data acquisition and retrieval system to address the problems and drawbacks heretofore experienced. The primary objective of this invention is to meet this need.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a data acquisition and retrieval system which allows users immediate real time access to all existing customer/product information.

It is an object of the present invention to provide a data acquisition and retrieval system which affords users access to wireless remote data terminals.

It is an object of the present invention to minimize the data retrieval time by reducing the necessary information transmitted between handheld units and the corresponding communications server.

It is another object of the present invention to minimize the data necessary for transmission by synchronizing operation within each handheld unit and a corresponding communications server, such synchronization including the minimization of header information for each transmission and the transmission of a command case code used directly by the command server to access a designated database.

It is another object of the present invention to provide a user interface which minimizes user error.

It is another object of the present invention to provide a user interface which utilizes an event driven architecture to allow data entry through a touch pad.

It is another object of the present invention to provide a user interface which is easily operated by using a touch pad which presents a scroll bar, rolling keys and icons for data entry.

It is another object of the present invention to provide a user interface which allows for the scanning of bar codes to identify particular customers or products.

These and further objects will become more apparent from the drawings and detailed description hereafter.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the invention noted above are explained in more detail with reference to the drawings, in which like reference numerals denote like elements, and in which:

FIG. **1** is a block diagram of an overview of a data acquisition and retrieval system according to the present invention;

FIG. **2** illustrates a block diagram of a handheld interface according to the present invention;

FIGS. **3**(*a*), **3**(*b*), **3**(*c*), and **3**(*d*) illustrate exemplary display screens shown on the handheld interface according to the present invention;

FIG. **4** illustrates the main processing loop by which the handheld interface monitors and responds to events selected by the user;

FIG. **5** illustrates the processing sequence of the handheld interface while displaying a patient information screen;

FIG. **6** illustrates the processing sequence of the handheld interface to initiate the patient information screen;

FIGS. **7**(*a*) and **7**(*b*) illustrate the processing sequence of the handheld interface while displaying a patient input screen;

FIG. **8** illustrates the processing sequence of the handheld interface to initiate the patient input screen;

FIG. **9** illustrates the data structure of the packets transmitted between the handheld interface and the communications server;

FIG. **10** illustrates the processing sequence undergone by the handheld interface to write data packets to the communications server;

FIG. **11** illustrates the processing sequence by which the communication server reads packets transmitted from the handheld interface;

FIG. **12** illustrates the processing sequence by which the communication server parses through a short header structure within an incoming packet to build the input buffer;

FIG. **13** illustrates the processing sequence by which the communication server parses through a long header structure within an incoming packet to build the input buffer;

FIG. **14** illustrates the processing QUEUE sequence to move completed messages to the processing QUEUE;

FIG. **15** illustrates the processing sequence by which the communication server generates the processing queue;

FIG. **16** illustrates a block diagram of the RAM section of the handheld interface;

FIG. **17** illustrates a block diagram of the communications server;

FIG. **18** illustrates an alternative data entry display for the handheld interface; and

FIG. **19** illustrates the processing sequence of the command server to process and transmit message lists.

DETAILED DESCRIPTION OF THE INVENTION

Overview

FIG. **1** illustrates a data retrieval/acquisition system according to the present invention generally illustrated by the reference numeral **1**. The instant system **1** includes a master server **2** which communicates with multiple remote input units **4** through a communications bus **6**. Each input unit **4** includes a communications server **12** directly connected to a command server **14** and data bases **16**. Each remote communications server **12** interactively communicates with one or more handheld user interfaces **8** while located within a predefined region **5** proximate thereto. This interactive communication is conducted through a wireless dedicated communication channel, such as upon an infrared carrier signal.

The communications server **12** controls all interaction between the handheld interfaces **8**, the command servers **14**, and the communications bus **6**. The command servers **14** control direct access to the databases **16**. The command servers **14** may implement any conventionally known IO management system, such as Pro-Tree (version 2.0), SQL or Paradox. The communications server **12** communicates with each handheld interface **8** through a unique communications protocol (hereafter referred to as the Handheld-Server Protocol). The communications server **12** communicates with the command servers **14** through a unique protocol (hereafter referred to as the Message List Protocol).

As explained below, the communications server **12** synchronizes its operations with those of the handheld interfaces **8** to minimize the excess data necessary for each transmission therebetween. The communications server **12** and interface **8** also utilize shorthand code values to identify constantly transmitted information, such as commands, user IDs, database IDs, and the like. By synchronizing operation of the handheld interface **8** and the corresponding communications server **12**, the instant system is able to avoid the need to transmit the user ID, time, date, authorization code, and the like during every transmission.

During operation, the user enters data at the handheld interface **8**, the data is transmitted to the communications server **12** and stored internally within the database **16**. Data may also be entered directly into the communications server **12**. Similarly, the user may request data previously submitted, in which case the communications server **12** accesses the corresponding database **16**, through the command server **14**, and transmits the necessary desired information to the requesting handheld interface **8**. Throughout operation, a backup copy may be maintained within the master server **2** for every remote database **16**. Additionally, the user may request, via the handheld interface **8**, data stored within a remote input unit **4** other than the data in the databases directly connected to the receiving communications server **12**. In such a circumstance, the corresponding communications server **12** would accept the request from the handheld interface **8**, determine that the desired information is stored within a remote database and request such information through the communications bus **6** from the communications server **12** containing the corresponding database. Thus, the communications bus **6** also allows data to be transmitted between communications servers **12** and between handheld interfaces **8** (such as when one doctor is requesting information from another doctor).

By way of example only, the instant acquisition/retrieval system **1** may be utilized within a healthcare facility wherein doctors, nurses, and staff utilize the handheld interfaces **8** to record and obtain patient information. These persons may be assigned different privileges which would allow varying levels of access to data. In this environment, each communications server may be located within a different ward or testing laboratory. Thus, a doctor in a general ward may need to send a message to, or obtain information from, a doctor

or nurse in radiology. To do so, the doctor would transmit a request through the handheld interface **8**, with the request being received and decoded in the general ward's communications server **12**. The source/receiving communications server determines the appropriate destination communications server that corresponds to the destination handheld interface, into which the destination doctor or nurse has signed on. The desired message is transmitted to the radiology server, and to the corresponding handheld interface which queries the user through audio, video, or vibrating means. In a similar manner, the user within radiology may transmit a response through the corresponding radiology and general ward communications servers **12** to the requesting doctor's handheld interface **8**. Also, lab data may be quickly transmitted to a surgeon during an operation.

The instant acquisition/retrieval system **1** also allows doctors, nurses, and staff members immediate access to clinical data, even after clinic hours are closed. To do so, the user merely enters a request through his/her handheld interface **8**, which is transmitted through the corresponding communications server **12** to the clinical communications server **12**. The necessary clinical data is obtained from the clinical database and returned along the communications bus **6**. By way of-example, the data acquisition/retrieval system **1** of the healthcare facility may be connected to similar systems via an ethernet connected between the master servers **2**.

The handheld interfaces **8** are used to enter all patient information such as personal information upon admittance, past medical histories, vital statistics throughout their stay in the hospital, and the like. For instance, these vital statistics may include systolic, diastolic, pulse, temperature, and respiratory information. Similarly, the handheld interface **8** may be used to enter information concerning the patient's fluid intake and output.

As will be explained below, the instant data acquisition/retrieval system **1**, also allows a user to carry a handheld interface **8** between regions (see the dashed line **5** in FIG. **1**) dedicated to each communications server **12**. Optionally, when this occurs, the handheld interface **23**, is considered to have signed off with the old communications server (as illustrated by the dashed line **22**). Thereafter, the handheld interface **23** must be signed onto the new communications server (as illustrated by the line **24**) before it may be used for data entry.

The manner by which these objects and functions are achieved will become clear in connection with the following explanation of each module of the present invention.

Handheld Interface

FIG. **2** generally illustrates a block diagram of a handheld interface **8** having a display screen **30** which may be back-illuminated and which is controlled by a CPU **32** to display desired information thereon. The display screen **30** also functions as a touch pad and is sensitive to user contact. When contacted, the display screen **30** outputs a signal to the CPU **32** identifying the exact location of the contact therewith. The handheld interface **8** further includes a memory module **34** which stores software to control processing of the CPU **32** and which temporarily stores data received from, and transmitted to, the corresponding communications server **12**. The CPU **32** controls an IR interface **36** to control data transmissions to and from the communications server **12**. A bar code reader **37** is included to allow the user to enter customer or product information from a bar code, such as customer/patient ID and the like.

As explained below, the handheld interface **8** operates as an "event driven" device wherein the touch screen **30** is drawn to display a desired arrangement of virtual regions. Each region is assigned a unique identifier. The handheld interface **8** recognizes each contact by a user as an event. The contact/event is recognized with respect to the correspondingly defined region and the region identifier is returned. Thereafter, the CPU **32** identifies the necessary course of action based upon this identifier.

As illustrated in FIG. **3**, during operation the CPU **32** may display a variety of menus, graphs, and the like upon the touch screen **30**. Within each display, the CPU **32** defines virtual regions which correspond to predefined processing sequences. The user initiates a desired event sequence by contacting the preferred region corresponding to the event. To facilitate the user interaction therewith, the CPU **32** provides multiple manners in which the user may enter and retrieve data. As illustrated in FIG. **3**(*a*), the CPU **32** draws a main menu **38** on the screen **30** and defines multiple menu selections **40** therein (see the flowchart of FIG. **10**). Each menu selection **40** overlays and corresponds to a virtual event region **42** corresponding to a different event/case. Every screen **30** is displayed with an escape key **43** which allows the user to escape back to a previous function/screen or back to the main menu.

When implemented in a healthcare application, as illustrated in FIGS. **3***a*–**3***d*, when the user selects a vitals event region **44**, the CPU **32** recognizes it as such and processes a corresponding event sequence (see FIG. **13**).

As illustrated in FIG. **3***c*, the vitals input screen **60** (also referred to as the data I/O screen) displays current patient information in the patient field **62**, such as the patient's name, social security number, status, and the date upon which the vitals were last updated. The vitals input screen **60** illustrates the last current vitals (data sets) as shown in the systolic field **46**, diastolic field **48**, pulse field **50**, temperature field **52**, and respiratory field **54** (collectively referred to as data fields). The touch screen **30** allows the user to activate a desired vital sign field by selecting a corresponding icon **46**, **48**, **50**, **52**, and **54**, respectively. Located immediately above each icon is the current value for the corresponding vitals field. This current value is also displayed within three rolling keys along side of the icon (the rolling keys are designated by the reference numeral **56**). The patient's systolic vital sign field is active in FIG. **3***c*, as evidenced by the inverted rolling keys **56**. Proximate the rolling keys **56** is a scroll bar **58** for illustrating in a bar format the current value of the active vital sign field (i.e., systolic) which is inverted to the current level (**130**).

To enter new patient vitals, the user may do so in multiple ways. First, the user may update the patient's systolic vitals by consecutively contacting each rolling key **56** to be incremented. Each rolling key continuously increments, such as from 0 to 9 and then back to 0. Alternatively, the user may enter patient vitals information by contacting the scroll bar **58** at the desired position. In accordance with the flowchart of FIG. **13**, when the user contacts the scroll bar **58**, the bar is updated to reflect the newly entered value. If the user drags his/her finger along the scroll bar **58**, the CPU **32** will continuously update the level thereof to reflect this movement of the finger. The CPU **32** updates the corresponding rolling keys **56** for the active field (i.e., the systolic field as illustrated in FIG. **3**(*c*)). The user may drag his/her finger across the scroll bar **58** until the desired value is displayed in the rolling keys **56**, at which time the user releases the scroll bar. The user may activate a different vital sign field (i.e., change the mode) by selecting the corresponding icon (**46**, **48**, **50**, **52**, and **54**).

The vitals input screen **60** further includes change function keys **64** which afford the user's direct access to displays, graphs, screens and the transmit function. More specifically, the vitals input screen **60** allows the user direct access to the fluids input screen (not shown) for the current patient by pressing the fluids function button **66**. Alternatively, the user may view the selected vital sign field (e.g., systolic field) in a graph format by selecting the view graph button **68**. The vitals input screen **60** further includes a transmit information button **70** which the user selects once a patient's new vital information has been entered. When the transmit button **70** has been pressed, the CPU **32** transmits the updated patient information to the communications server **12** in a format described below.

FIG. **3**(*b*) illustrates a graph corresponding to the present patient's systolic vitals which is displayed when the view graph button **68** is selected.

FIG. **3**(*d*) illustrates a patient inquiry screen **74** selected from the main menu **38** (also referred to as the data set inquiry screen). The patient inquiry screen **74** displays a scrolling text window **78** which exhibits the currently selected patient's name (data set header) and those names alphabetically proximate thereto. Along one side of the scroll text window **78** is positioned a scrolling bar **80** which includes an identifier **82** designating the position of the currently selected patient's name within a master alphabetical list. The user may scroll through the patient list by contacting the scrolling bar **80** at a desired location therealong. The top and bottom of the scrolling bar **80** corresponds to the beginning and end, respectively, of the list of patient names stored within the handheld interface **8**.

The patient inquiry screen **74** also includes a virtual keypad **76** which allows the user to enter the name of a desired patient. As the user selects each letter of the desired patient's name, the CPU **34** automatically performs a search upon the entered letters and updates the scroll text window **78** correspondingly. As the user enters additional letters, the CPU **32** concatenates these letters to the end of the search string it uses and again updates the scrolling text window **78**. The patient inquiry screen **74** also includes function buttons **64** along a bottom thereof to allow the user to automatically jump to an alternative screen. A scan button **77** is included to allow the user to read bar code data from a patient's wrist band, such as patient ID.

FIG. **18** illustrates an alternative scroll bar implementation which may be used to allow the user to enter alphanumeric information. For instance, the CPU **32** may control the display screen **30** to illustrate a display field **90** and one or more scroll bars **92**. The scroll bar **92** may be defined such that one end corresponds to the letter A while the opposite end corresponds to the letter Z. The CPU **32** would define multiple regions along the length of the scroll bar **92**, each region corresponding to one letter of the alphabet. When the user contacts the scroll bar **92**, a letter corresponding to the touched regions is displayed in a first location **94** of the display field **90**.

As the user drags his/her finger along the scroll bar, the letter displayed within the first location **94** will vary corresponding to the currently selected region. Once the user removes his/her finger from the scroll bar **92**, the last identified region is designated as the correct letter and entered in the first location **94** of the display. When the user again contacts the scroll bar **92**, the CPU **32** operates to display a corresponding letter in the second field location **96** of the display field **90**.

If it is desirable to enter numerals within the display field **90**, the CPU **32** may also draw a second scroll bar **98** upon the display screen **30**. The first end of the second scroll bar would represent a 0 while the second end of the scroll bar **98** would represent a 9. The user would enter numerals in the display fields **90** in the same manner as discussed above with respect to letters. Optionally, a single scroll bar may be provided for letters and numerals with function buttons **100** and **101** being used to assign letters or numerals to the scroll bar.

FIG. **15** illustrates the RAM section **35** of the memory within the handheld interface **8**. The RAM memory **35** includes a patient information section **200** for storing a list of patient names (data set headers) and patient identifiers (data set identifiers) associated with the present user of the handheld interface **8**. The RAM memory **35** also includes a working space **202** for storing all other information entered by the user and transmitted between the handheld interface **8** and the communications server **12**. Each time the CPU **32** transmits a request to the communications server **12** for patient information, the CPU **32** redefines the current data structure within the working space **102** to correspond to the expected format of the return data from the communications server **12**.

By way of example only, when the CPU **32** requests patient vitals, it expects the returned data to include, in a preset order, the patient's social security number, date on which the patient vitals were last updated, and the most recent systolic, diastolic, pulse, temperature and respiratory values. The CPU **32** sets up fields within the working space **202** for each of these values. When the returned data is received, the CPU **32** parses through the returned packet and assigns bytes therefrom to the desired field in the working space **202**.

The RAM **35** further includes a temporary buffer for storing incoming and outgoing packets of information which are to be transmitted to and which are received from the communication server **12**. The CPU **32** moves data from the RAM **35** into the temporary buffer **204** immediately before transmitting this information and adds a packet header **206** thereto.

FIGS. **4**–**8** illustrate the processing sequence by which the CPU **32** controls the main menu, vital sign patient/data set input screen and the patient information screen (FIGS. **3***a*–**3***d*).

Generally, during operation the CPU **32** loops through one of two primary case/event handling loops (FIG. **4**). The first case/event loop operates to draw the main menu (FIG. **3***a*) and to handle events chosen from the main menu. When an event occurs which corresponds to a defined key region within the main menu, a corresponding event identifier is returned as the calling identifier. A return code is set equal to this calling identifier and the return code is checked against a predefined value (0). If the return code is non-zero, processing flow enters the second primary loop to call the corresponding event handling function. The second primary loop corresponds to processing in which a menu other than the main menu is displayed (FIGS. **3***b*–**3***d*). During this second loop, a code which identifies the next function to be performed is continuously checked. When the code equals zero, processing returns to the main loop. When the code is a nonzero value, the corresponding function is called. Once each function is completed it returns a code identifying the next function to be performed by the user. This configuration reduces the memory requirements by reducing the levels of functions to be called, thereby reducing the necessary stack space.

FIG. **4** generally illustrates the processing undergone by the handheld interface **8** when the user initiates the first

session (i.e., when the user first logs in). When a session is initiated the handheld unit prompts the user for the user's ID and password (step **1602**). Next, a packet is constructed in the temporary buffer **204** which contains a long header **206** structure and has a data section including the user ID and password (step **1604**). This packet is transmitted (step **1606**) and a validation code therefor is waited upon. If the validation code is not received (step **1608**) processing returns to step **1602** in which the user is reprompted for the ID and password. If a validation code is received, processing continues to step **1610** in which a return code is set to indicate that processing should move to the patient inquiry module. Thereafter, the return code is tested to determine whether it equals zero (step **1623**). If the return code equals zero, processing returns to step **1614** in which the main menu is redrawn.

After this initial login sequence is completed, flow enters the main event handling loops. First, a main menu is drawn and key regions therein are defined in steps **1612** and **1614**, after which the system waits for an event to occur (step **1616**). Once an event occurs, it is determined whether the event is within a defined menu regions **42** (step **1618**) (i.e., whether the user has touched the display screen **30** at a location corresponding to a menu selection **40**). If not, processing loops back to wait for the next event. If so, an event identifier is obtained for the key region in which the event occurred (step **1620**). Next, an event handling function corresponding to the event identifier is called (step **1622**). Thereafter, processing waits for a call identifier returned from the called event handling function. A return code is set equal to the call identifier (step **1623**) and the return code is tested in step **1624** and if zero, processing returns to the initial step **1612** to redefine and redraw the main menu. If the return code does not equal zero, the process determines that the user has selected another function besides displaying the main menu. Thus, the event handling function corresponding to the non-zero return code is called (step **1626**). Thereafter, the main event handling loop waits for the called function to return a call identifier which is tested in step **1624**.

FIGS. **5** and **6** illustrate the process undergone when the patient information screen **74** is selected to be displayed (such as during the wake up function or when called by the user). First, an initialization routine is called in step **1700** (steps **1710–1720** in FIG. **6**). This initializing process begins by determining whether the handheld interface **8** includes a list of patient names (data set headers) and IDs (step **1710**). If this list does not exist (such as when the handheld interface has initially been woken up), the unit constructs and transmits a packet to the communications server **12** requesting the patient list associated with the currently signed-in user (step **1712**). The communications server **12** receives this packet, identifies the user ID, and requests the appropriate information from the command server **14**. Thereafter, the appropriate database **16** is read and the patient list for the user is transmitted back to the handheld interface **8**. After the interface **8** sets up the data structure in the patient memory **200** for the patient list (step **1714**), it waits for the returned patient list (step **1716**). Once the patient list (name and ID) is received, it is stored in the patient memory **200**.

The handheld interface **8** may not include sufficient display space in the scrolling text window **78** to show an entire patient's name. Thus, the patient memory section **200** will only include sufficient memory to store the maximum number of characters which may be displayed for a single patient name upon the screen. Once the patient list is stored, the patient screen format is displayed (step **1718**) as illustrated in FIG. **3***d*. Next, the patient names are displayed in the scrolling text window **78** (step **1720**) (FIG. **3***d*). When the patient list is too long to be completely displayed within the scrolling text window **78**, a default portion thereof is displayed. Next, the system waits for an event (step **1722**, in FIG. **6**) and when one occurs, an event identifier is assigned thereto.

The event identifier is passed to a case/event statement which includes every possible valid value for the event identifier. By way of illustration, processing will continue along one of six possible processing paths to blocks **1724**, **1726**, **1728**, **1730**, **1750** or **1756**, depending upon which event occurred. When event **1724** occurs (i.e., the user presses the escape icon), the system returns a zero calling identifier to the main loop (thereby indicating that no new event handling function has been selected). If the event indicates that the user has touched the scrolling bar **80**, processing flows to box **1726** in which the system determines the exact location of the event (step **1732**). This location is correlated with a pointer that is used as an index into the patient list to identify the new patient to be displayed in the scrolling text window **78**. Once the event location is determined, the pointer into the patient list is updated and the scrolling text window **78** is redrawn to display the name of the selected patient and a limited number of patient names surrounding the selected name (step **1734**).

Next, the scrolling bar **80** is updated to move the identifier **82** to a new position identifying the relative location of the indexed patient within the overall patient list (step **1736**). Thus, if the first patient is selected, the identifier **82** is redrawn at the top of the scrolling bar **80**, and if the last patient is selected, the identifier **82** is drawn at the bottom of the scrolling bar **80**. If the event is identified as occurring within the scrolling text window **78**, processing flows to step **1728**. Specifically, the location of the event is again identified (step **1738**) relative to the names currently displayed. The name closest to the event is identified as the selected patient. Thereafter, the pointer into the patient list is updated to index the newly selected patient name (step **1740**). This name is displayed in the center of the scrolling text window and, optionally, may be inverted in color (step **1740**). The identifier **82** within the scrolling bar **80** is also redrawn to properly identify the new position of the selected patient within the patient list (step **1740**).

If the keypad **76** is touched, processing flows to block **1730**, at which the letter is identified which corresponds to the region touched (step **1742**). This selected letter is added to a temporary patient searching string within the work space memory **102** (step **1744**). This letter is added to a search string (which is empty until the first letter is selected). Thereafter, the processor conducts a search based upon the search string into the patient list to identify the name most closely corresponding to the letter(s) selected from the virtual keypad **76** (step **1746**). If a search string exists (i.e., the user has already entered some letters) the newly selected letter is concatenated onto the search string and a new search is conducted upon the text strings within the patient list to find the first text string which is greater in alphabetic value than (i.e., closest to) the search string. The pointer is set to the closest patient name and the scrolling text window **78** and the scrolling bar **80** are updated (steps **1746** and **1748**). If the user wishes to delete a letter from the search string, he/she simply pressing the delete region key.

If the user selects the scan region **77**, processing flow moves to block **1750**. The bar code scanner is read to obtain the bar code scanned by the user (step **1752**) (this bar code

may appear on a patient's wrist band and the like). The bar code includes the patient ID, which is used to find the patient name within the patient list (step **1754**). Next, the pointer into the patient list is updated (step **1756**) and the scrolling text window **78** and. scrolling bar **80** are redrawn (step **1758**).

Once the user has selected a desired patient, the user may escape from the patient inquiry screen by pressing the escape icon **43** in the upper left corner or by selecting one of the function **64** buttons at the bottom of the screen (step **1760**). As illustrated in FIG. **3***d*, the user may escape to the main menu, review a patient's information complete record or review the patient's vitals. If the user presses one of the change function buttons **64** at the bottom of the screen, the corresponding event identifier is evaluated to determine which function key the user has selected (step **1762**) and the corresponding return code is returned to the main processing loop in FIG. **16** (step **1764**).

FIGS. **7***a*, **7***b* and **8** illustrate the processing sequence undergone by the handheld interface **8** when the vitals/data input/output handling function is chosen (i.e., when a user desires to enter patient vitals). First, the display screen is cleared (step **1800**) and the vitals (data I/O) format is drawn upon the screen (step **1802**). Similarly, the key regions are defined which correspond to each even identifier. Next, it is determined whether the workspace memory contains vitals for a selected patient (step **1804**). If not, the processor constructs and transmits a packet (step **1806**) requesting patient vitals. Thereafter, the workspace memory **202** is set up in the data structure corresponding to patient vitals (step **1808**). Thereafter, the handheld interface waits for the returned patient vitals, receives these vitals in one or more packets and disassembles the packets and stores the patient vitals in the workspace (step **1810**). Next, the processor draws the patient vitals onto the screen (step **1812**) and sets the default mode to a predetermined field (e.g., systolic field). The vitals for the default field are drawn into the scroll bar (step **1814**) and the default rolling keys **56** corresponding to the default field are inverted. Thereafter, the handheld interface,waits for an event to occur (step **1816** in FIG. **7***a*) and when it occurs, identifies the event number corresponding thereto.

Processing flows along one of six paths depending upon which event number is identified. While each field upon the vitals screen corresponds to a separate event number, the events as displayed in FIG. **8** may be grouped into six general categories, namely, touching a roll key, touching the icon, touching the scroll bar, touching the patient's general information, touching the escape key, and touching the change screen buttons (blocks **1818**, **1830**, **1840**, **1852**, **1858** and **1864**). Once the event number is identified as corresponding to a rolling key **56**, it is determined whether the touched rolling keys are active (step **1819**). If not active, processing returns to step **1816**. If active, a pointer is determined which identifies the field within the workspace memory **202** which corresponds to the specific roll key/vital sign selected (step **1820**).

Next, the data value identified by the pointer into the workspace is incremented by a 1, 10, 100, etc. depending upon the rolling key which was touched (step **1822**). Thus, referring to FIG. **3***c*, if the user presses the center rolling key corresponding to the systolic field, the systolic data value within the workspace memory will be incremented by 10. Similarly, if the diastolic field is selected and the user presses the leftmost rolling key therein, the processor will increment the diastolic data value within the workspace memory by 100. Next, it is determined whether or not the incremented value has created an overflow and if so, the incremented digit is rolled-over (step **1824**). This rollover function is performed to rotate a rolling key having a current value of 9 to a new value of 0.

Thus, if the user selects the pulse vital and contacts the "1s" rolling key (which has a present value of 9), the processor will update the pulse value within the workspace memory to "80". Thereafter, the new vital sign is drawn into the rolling keys **56** which have been updated and the new vital sign is stored in the corresponding field in the workspace memory (step **1824**). Finally, the processor updates the scroll bar **58** to reflect the change in the current data value (step **1826**).

If the event identified in step **1816** corresponds to an icon, processing proceeds to step **1830**. First, the rolling keys are deactivated for the previously active vital sign field (step **1832**) and the rolling keys for the newly chosen vital sign are activated (step **1834**). Next, the rolling keys for the deactivated and newly activated vital sign fields are inverted to display the newly active field to the user (step **1836**). Thereafter, the scroll bar **80** is redrawn with parameters, ranges and current vital signs corresponding to the newly selected vital sign field (step **1838**).

When the identified event corresponds to touching the scroll bar **80**, process flows to step **1840**. Once the scroll bar is touched, the exact location of the event is determined therein and used to identify the corresponding vital sign value (step **1842**). Then, a pointer is determined which identifies the vital sign data value within the workspace memory which corresponds to the active vital sign field (step **1844**). This vital sign data value is updated to the new vital sign value selected within the scroll bar (step **1846**). Thereafter, the active scroll keys are updated with the new data value (step **1848**) and the scroll bar is inverted to reflect the new data value (step **1850**). When the event occurs within the patient information region, processing flows to step **1852**. In such a case, the patient information screen is redrawn. To do so, a calling identifier is set to correspond to the patient information screen (step **1854**) and control is returned to the main loop (step **1856**).

Optionally, when the user touches the patient information region, a pop-up window may appear and query the user as to whether it is desirable to go to the patient information screen or enter a patient identifier through the bar code reader. In either case, if the user touches the patient information region, before new patient vital signs have been transmitted to the communication server, the user is prompted as to whether or not these vital signs should be transmitted. When the escape icon is touched, processing flows to step **1858**, after which the calling identifier is set to zero (step **1860**). Processing is returned to the main loop (step **1862**).

If the screen changing buttons are touched, processing flows then to step **1864**, after which the selected button is determined (step **1866**). In step **1867**, it is determined whether the event corresponds to the transmit button. If the selected button corresponds to the transmit button, the current patient vitals are constructed into a packet format and transmitted to the communication server **12** (step **1868**). If the selected button does not correspond to the transmit button, the calling identifier is set equal to the newly selected screen (step **1870**). Thereafter, control is returned to the main loop (step **1872**).

When the return code within the main loop is set to correspond to the view graph display screen (FIG. **3***d*), the processor determines the active vital sign field (e.g., systolic

field), and obtains the corresponding default parameters for the graph. Thereafter, the screen is cleared and a graph having the parameters for the active vital sign field is drawn. Next, the vital sign data values for the active vital sign field are read from the workspace memory and used to draw the graph.

Optionally, in the view graph screen a series of changing function buttons may be displayed along the bottom thereof. These buttons would allow the user to automatically select another vital sign to view in a graph format without intermediately returning to the vital input screen.

In accordance with the above procedure, the handheld interface **8** allows for user inputs and displays patient information to the user.

Interface-Server Protocol

Once the user enters the desired data and wishes to send this data to the communications server **12**, the user presses the transmit function button **70**. Once the CPU **32** identifies that an event has occurred which corresponds the transmit function button **70**, the main loop (FIG. **4**) calls the transmit handling function. FIG. **4** illustrates the process by which the CPU **32** transmits data to the communications server **12**.

As illustrated in FIG. **9**, each transmission comprises an information packet **300** of IR signals corresponding to a packet of data, wherein every packet is constructed with the same predetermined length (e.g., 128 bytes) and in one of two formats. This length is software and operative system definable and may vary. Certain messages transmitted between the handheld interfaces **8** and the corresponding communication servers **12** comprise an amount of data which is unable to be assembled into a single packet. Thus, in such circumstances the transmitting device segments the data into a plurality of equal length packets **300** (referred to as frames). The series of frames form a message **302**.

When transmitting a message the first packet/first frame thereof is constructed with a header section **304** formed in a long header structure followed by a data field **306**. The long header **304** includes a 4 byte command field **308**, a 6 byte user identifying field **310**, and a 4 byte message total field **312**. The command field **308** identifies the process to be performed upon the subsequent data, the user ID identifies the user signed into the handheld interface **8** transmitting or receiving the packet **308** and the message total **312** identifies the total length of the message which will follow. This total length includes all bytes within subsequent packets **300** corresponding to this specific message **302**. Thereafter, a data field **314** (having 114 bytes in a packet with a 128 byte structure) follows.

If the message includes more data than will fit in a single packet, subsequent packets/frames are transmitted. These subsequent packets/frames are constructed with a short header structure **316** preceding the data segment **318**. The short header **316** includes a 4 byte command **320** and a 4 byte positioning packet **322** identifying number to enable the receiving device to determine the position of the packet within the overall message. Packets containing a short header **316** includes a 120 byte data field for a packet formed with 128 bytes. During transmission, the first packet of each message includes a long header **304** structure followed by a data field, with each subsequent packet within the message including a short header **316** structure followed by a data field. In this manner, the device is able to increase the amount of data transmitted within each packet for long messages. The transmitting device need not send the user ID and the message total more than once for a given message since the receiving device is able to associate corresponding packets with a single message **302** based on the packet number **322** and communication channel.

To transmit a message (FIG. **10**), the CPU **32** reads the current data from the workspace memory **200** in the RAM **35** (step **400**). Next, the CPU **32** determines the length of the message and the ID of the user signed in to that handheld interface **8** (step **402**). The CPU **34** constructs a packet header formed with the long header structure (step **404**). The CPU **34** clears the packet number (step **406**) and writes the data to the transmit buffer (step **408**). If the packet is full (step **410**), the CPU **32** transmits the packet and clears the buffer (step **412**). If the packet is not full, it determines if more data exists to write to the buffer (step **414**). If no more data exists, it transmits the packet. If more data exists, it again writes to the packet. In step **416**, it is determined if more data exists, and if not it exits. If so, the packet number is incremented (step **418**). Next, the CPU **34** constructs a partial short header for the second frame to be transmitted in this message (step **420**). The partial header includes the code for the corresponding command and the current packet number. Thereafter, the next segment of data is written to the packet (step **408**) and steps **410** through **426** are repeated. Once the last packet is transmitted (step **414**) and it is determined that no more data remains to be written to the packet (step **416**), the system exits the transmit routine (step **422**).

Communication Server

FIG. **16** illustrates a block diagram of the communication server **12**. The communication server **12** includes an IR receiver/transmitter **100** which receives and transmits IR communication packets from and to the handheld interface **8**. The IR receiver transmitter **100** operates in conjunction with an I/O card **102** to store a packet of information from each communication channel in the corresponding address within a temporary buffer **104**. Each communication channel corresponds to a unique handheld interface **8**. For instance, the communication server **12** may provide for **128** IR channels and thus, the temporary buffer **104** will include **128** buffer locations, with each buffer location having sufficient memory to store a complete IR packet **300** (FIG. **9**). The number of channels is locally definable and may be any desired number. The array locations within the temporary buffer **104** store the IR packets in the format transmitted from the handheld interface **8** as described above.

The communications server **12** further includes an input buffer **108** which represents a storage space used by the CPU **106** when converting packets from the format stored in the temporary buffer **104** to message lists with a different format to be transmitted to the command servers **14**. The input buffer **108** represents an array, each element of which includes the COM_INFO structure (explained below).

Each element of the input buffer **108** array is accessed based on the device number. Thus, if **128** handheld interfaces **8** are being used, the input buffer **8** will include **128** elements.

The communications server **12** further includes a message buffer **110** which is utilized to store the actual data for each complete message sent from the hand held interface once all of the necessary packets have been transmitted by the handheld interface **8** and reassimilated by the CPU **106** into a single message. The COM_INFO stored in the input buffer **108** includes a pointer MSG_From_HH into the message buffer to the beginning of the corresponding data string. Once every packet **300** for a message **302** is received

and the corresponding data is stored in the message buffer and the COM_INFO is stored in the input buffer **108**, the CPU **106** constructs a message list therefrom. Each message list to be processed by the command server **14** is stored on one of a process queue **114**. The message list includes a pointer to the corresponding data string in the message buffer **110**. Each message list received from the command server **14** is initially stored in a transmit queue **116** prior to being converted back into packets **300** and transmitted to the handheld interface **8**. The message list includes a pointer to a corresponding data string which is stored in the message buffer **110** when it is received from the command server **14**.

The process and transmit queues are operated in a first-in-first-out sequence such that each message is processed or transmitted in the order in which it is placed in the queue. The transmit and process queues **112** and **114** constitute dynamic queuing systems which attach message lists in a linked list structure. Each message list includes the data structure illustrated below:

MESSAGE LIST					
COM_INFO 10	Data File (Integer)	Command (1)	MSG_TO_HH (Pointer)	MSG_LEN (Long Integer)	Prev MSG_LST (Pointer)

COM_INFO							
Device Number (Integer)	CMD (4)	Packet Number (Long Integer)	User ID To (6)	User ID From (6)	MSG Total (Long Integer)	MSG Length (Long Integer)	MSG From HH (Pointer)

The message list data structure includes a first section COM_INFO dedicated to, and containing information concerning, messages received from the handheld interface **8**. The next four fields represent fields which are created immediately before transmitting a message list to the command server **14** and another communications servers **12**. The final field (Previous MSG_LST) is used as a pointer to the subsequent message list within the queue to be processed. The first section COM_INFO includes a device number uniquely identifying the handheld interface transmitting the message. The device number is generated by the I/O card **102** when the CPU **32** requests a packet **300** from the temporary buffer **104**. The device number is produced depending upon the communications channel being accessed. The command (CMD) includes the structure of the CMD field transmitted in the header of each packet **300** (i.e., the 2 byte database ID, 1 byte command ID, and 1 byte reserved).

The command (CMD) represents the command to be processed in accordance with the corresponding message being transmitted to or from the handheld interface **8**. The 4 bytes within the command are separated such that the first two bytes identify the database to be processed when performing the command, the third byte stores a number corresponding to the specific command to be performed, and the fourth byte is reserved. By way of example, with respect to the third. byte, numerals **1–127** represent commands to be processed by the command server, while numerals **128–255** represent a command from the handheld interface **8**. As noted above, the use of shorthand code numbers for specific commands reduces the amount of data to be transmitted to and from the handheld interface **8**.

The Packet Number is a long integer which is incremented each time a packet is appended to a message on the input buffer **108**. The User_ID_To is a 6 byte value added by the handheld interface **8** to identify a destination user. If set to zero, the destination is the communications server. The communications and command servers determine which server to send the command to. This value if non-zero will identify the user of a handheld interface **8** desiring to communicate therewith. The User_ID_From is a 6 byte value added once at login time. This user ID is assigned to the channel to identify who is logged in at that channel. This value is maintained until the person signs out. Thus, the user ID will only be transmitted once during a login session. The communications server **12** keeps track of each User ID signed onto handheld interfaces served by that communications server **12**. The message total length (MSG_Total) is a value assigned by the handheld interface **8** or by the command server **14** when a message is transmitted. The message length (MSG_LEN) is a value updated by the short and long header parsing functions to keep track of the length of a message in the message buffer **110** as the packets for the message are added thereto. The message length field is initially tested by the communications server **12** when processing each packet in the temporary buffer **104** to determine if the packet is in a long or short header form. The message pointer field (MSG_From_HH) is a pointer into the message buffer to the location of the actual data message. The MSG_From_HH pointer is updated each time a new packet is appended to a message.

The message list structure includes the above COM_INFO structure as an addition to a Data_File field that represents an integer identifying the database, written from the COM_INFO structure, to be processed in connection with the corresponding command. The command (CMD) field represents a one byte command, written from the COM_INFO structure, to be processed. The MSG_To_HH field represents a message pointer used to point to the data compiled by the command server in connection with this message which will ultimately be sent to the handheld interface **8**. The MSG_LEN field represents a long integer identifying the current length of the data corresponding to the message and stored in the message buffer. The Previous_MSG_LST represents a pointer pointing to the next message to be processed. The previous message pointer enables the system to accomplish dynamic queuing for the process and transmit queues.

FIG. **11** illustrates the processing sequence by which the communication server **12** receives messages from the handheld interface **8**, processes these messages and transmits these messages to the command server **14**. First, the I/O card **102** is initialized, along with the communication channels, buffers and queues (step **700**). Next, the data structures for the message list, COM_INFO, CMD, and short and long headers are set up (step **702**). A current channel to be read by the I/O card **102** is initialized to the first channel (step **704**). Next, the current channel is tested to determine whether data is being transmitted thereon from the corresponding handheld interface **8** (step **706**). If data is present, the packet of transmitted data is read and stored in the temporary buffer **104** (step **708**). The packet of data is stored within the temporary buffer **104** at the array address corresponding to the current channel. A channel identifying number corresponding to the transmitting handheld interface **8** is also assigned thereto by the I/O card **102**.

Next, a check sum field within the data packet is tested to determine whether the transmitted data is valid (step **710**). If the data is invalid, the communication server takes the necessary corrective actions (step **712**). If the data is valid, the CPU **106** requests the channel number, (step **714**) and the

packet **300** from the I/O card **102** and utilizes the channel number to index the correct corresponding element within the input buffer **108**. Next, it is determined whether a packet is an initial frame or a subsequent frame of a message (step **716**). To effect this test, the message total field, within the element of the input buffer **108** corresponding to the current channel, is read and compared to zero. If the message total field equals zero, then a packet has not yet been written to this element of the input buffer **108**. Thus, the packet being read is identified as an initial packet which will include the long header structure. Otherwise, the packet is identified as one containing the short header structure. In either case, the packet number is incremented within the currently indexed element of the input buffer **108**.

If the packet contains the long header structure, processing moves to step **718** in which the parse long header function is invoked. If the packet includes the short header structure, processing moves to step **720** where the parse short header function is invoked.

FIG. **12** and FIG. **13** illustrate the parse long and short header functions. Within the parse long header function, the first four bytes of the data packet within the temporary queue is read as the command (step **722**). This command is compared with a list of valid commands and if the command is invalid the processor takes the necessary corrective action (step **724**). If the command is valid, the command is written to the command field within the element of the input buffer **108** indexed by the corresponding channel number (step **726**). Next, the subsequent six bytes of the packet within the temp buffer is read as the User ID, if present, of the destination user for the attached message/data. This six byte ID is stored in the UserID_To field of the element within the input buffer **108** indexed by the current channel number (step **728**). The User ID, corresponding to the signed on user, is added to the UserID_From field of the indexed element.

Next, the subsequent four bytes are read from the packet within the temporary buffer **104** as the total length of the following message (e.g., the total number of bytes to follow within one or more packets corresponding to the present message) (step **730**). The four byte value representing the message total is converted to a long integer (step **732**) and assigned to the message total field within the element of the input buffer **108** indexed by the current channel number (step **734**). Thereafter, the data section within the packet is written to the message buffer as a data string and the length thereof is stored within the message length field within the presently indexed element of the input buffer **108** (step **736**).

A message pointer pointing to the data string within the message buffer **110** is stored within the message pointer field of the indexed element within the input buffer **108** (step **738**). Finally, the element of the temporary buffer **110** is cleared (step **740**). In this manner, steps **718–740** parse through a packet having a long header structure, create the COM_INFO structure within the input buffer **8** and store the message **302** from the handheld interface **8** within the message buffer **110**.

Returning to FIG. **11**, if in step **716** it is determined that the packet is not an initial packet, then the short header function is invoked (see FIG. **13**). First, the first four bytes of the packet are pulled (step **742**) and compared with the value in the command field of the currently indexed element within the input buffer **108** (this command is indexed based on the channel number) to determine if these commands are the same (step **744**). If not, the system takes the necessary corrective actions (step **746**). If the commands correspond, the packet number within the short header is pulled (step **746**), converted to a long integer (step **748**) and compared to the packet number (plus one) within the indexed element of the input buffer **108** (step **750**). These packet numbers must correspond to ensure that the received packet is the next packet to be added to the input buffer **108**. If the packet numbers correspond, the present packet is identified as part of the message corresponding to the presently indexed element within the input buffer **108** and processing flows to step **752**, else it returns. If the packet is not matched based on above criteria, then a corrective action is taken.

Next, the data within the temporary buffer **110** is pulled (step **752**) and the portion of the message already stored in the message buffer **110** is read (step **754**). The new data is added to the end of the stored message and the new total string is rewritten to the message buffer **110** (step **756**). The message pointer (MSG_From_HH) and the message length (MSG_LEN) are updated within the corresponding fields of the COM_INFO of the indexed element of the input buffer **108** (step **758**). Thereafter, the control returns to the main process (step **760**).

Referring to FIG. **11**, once control is returned to the main program, the current channel is incremented (step **760**). Next, it is determined whether all channels have been checked (step **762**). If so, control is set to the processing sequence (at point A). If all of the channels have not been checked, control returns to step **706**. This process is continuously performed until all of the channels have been checked thereby transferring all packets of data from the temporary buffer **104** to the input buffer **108** and message buffer **110**.

Next, processing moves to the processing queue sequence (FIG. **14**) to move completed messages **302** to the processing queue **112**. First, the current element pointer into the input buffer **108** is set to the first input buffer element (step **800**). Then, it compares the message total length (MSG_Total) with the message length (MSG_LEN) to determine whether a complete message corresponding to the current element within the input buffer **108** has been received and stored in the message buffer (step **802**). If not, the incomplete message remains on the input buffer **108** and the current element pointer is incremented (step **804**) and the process returns to step **802**.

If the complete message for the current element has been received, the message is placed on the processing queue (step **806**) by creating a message list therefor. To do so, the command information (COM_INFO) of the current element of the input buffer **108** is written to the processing queue **112** and stored in the command information (COM_INFO) section therefor. As the corresponding message represents a transmission from the handheld interface **8** to the command server **14**, the next four fields of the indexed message list element in the processing queue remain undefined. This message list is "pushed onto the back" of the processing queue by storing, in the preceding message list in the processing queue, a pointer to the current message list. This pointer is stored in the final field (Previous_MSG_LST) within the previous, most recent message list added to the processing queue (step **806**).

Once the command information has been moved to the processing queue, the corresponding element of the input buffer **108** is cleared (step **808**). Thereafter, the current element pointer into the input buffer **108** is incremented (step **810**) and it is determined whether or not every element of the input buffer **108** has been tested (step **812**). If not, processing returns to step **802** and the next element within the input buffer **108** is processed. If processing is done on the

input buffer **108**, control moves to process the message lists on the processing queue.

The first element of the processing queue is tested to determine whether a command is stored therein (steps **900** and **902**). If a command exists on the processing queue, this command is "dequeued" (step **904**) by reading the message information from the processing queue (which is stored in the message list structure). The command field (CMD) within the COM_INFO section of the message list is read. The message is parsed into specific components (step **906**), by reading the first two bytes of the command field, converting these bytes to a long integer form and storing the data base identifier in the Data_File field of the message list (step **908**). Next, the third byte of the command (CMD) field in the COM_INFO structure is read and stored in the Command field of the message list (step **910**). Then the actual data message is appended to the message list structure based on the message pointer (MSG_TO_HH) and the message length (MSG_LEN) are reset (step **912**). The communications server **12** sends the message to the appropriate command server **14** based upon the database and command code (step **912**).

Next, the previous message pointer (Previous_MSG_LST) is read from the current message list to determine the next message to be processed on the queue (step **914**) and control is returned to step **902**. In this manner, each message upon the processing queue **112** is parsed through and transmitted to the appropriate command server **14**. When no more commands are on the processing queue, control is moved to the create transmit queue module (step **916**) (FIG. **15**).

FIG. **17** illustrates the process by which the communication server **12** processes messages upon the transmit queue which are to be sent to the handheld interface **8**. First, the first message upon the transmit queue is tested (step **1000**) to determine whether data is contained therein (step **1002**). If data exists, the message is dequeued by taking the message off the transmit queue (step **1004**). Next, the command information from the message list is read and a long header constructed for the first packet to be transmitted to the handheld interface **8** for the message (steps **1008** and **1009**). Next, the data from the message is written to the packet and transmitted (step **1010** and **1012**). Thereafter, it is determined whether additional data remains to be transmitted to the handheld interface **8** (step **1014**). If yes, a short header is constructed (step **1015**) and additional data from the message is written to the packet containing the short header (step **1016**).

Once constructed, the packet containing the short header is transmitted (step **1018**) and processing returns to step **1012** at which it is determined if more data remains. This loop is repeated until the entire message has been transformed from the message list structure into data packets and transmitted to the handheld interface **8**. Once the entire message has been transmitted, control passes to the next module (step **1020**).

The communications server **12** tests the communication bus **6** and determines if messages have been sent from other communication servers. First, the communications bus is tested to see if a message exists (step **1100**). If a message exists, the message is read (step **1104**) and the command therefor is decoded (step **1106**). Thereafter, the command is tested to determine whether the message should be transmitted to a corresponding handheld interface **8** or whether the message should be transmitted to a command server connected to the communication server **12** (steps **1108** and **1110**). Thereafter, the message is placed on the transmit or processing queue depending upon the destination of the message (steps **1112** and **1114**). Thereafter, control is returned to the main program (step **1116**). This process is continuously repeated until the communication server **12** is turned off. Once turned off, the communications channels are closed and the system is turned off.

Command Server

The command server operates to update the corresponding databases based upon messages received from the communications server. The command server utilizes a conventional software package for managing these databases, such as Pro-tree (version 2.0). Other database managing systems may be used to access the data base, such as DBase, CodeBase:, B-Trieve, Cisam and the like. Particular. commands within the conventional management system are called depending upon the command code and database codes transmitted within the message list.

FIG. **19** illustrates the process by which the command server **14** invokes the database management functions. First, the command server **14** receives a message (step **900**), including the complete message list structure followed by the data message. Next, the command server **14** reads the data base file field (step **902**) and determines whether that data base code is valid for the present command server **14** (step **904**). If not, it returns an error message (step **906**). If so, control is transferred to the database routine corresponding to the command code (CMD) in the Command field of the message list (step **908**). Next, it is determined whether the command code is correct for the addressed database (step **910**). If not, it returns an error code (step **906**). If so, it accesses the message data within the message list and performs the appropriate operation upon the data base (step **912**). Thereafter, it constructs a return message using the data returned from the database into the structure of the message list (step **914**) and quits (step **916**).

To invoke the database managing functions, the command number is processed within a case statement, whereby each case within the case statement corresponds to a unique command number. Each case statement calls the appropriate routines. For instance, command number **7** may represent an add command, and thus, case "7" would direct the command server to read the data from the message and write this data to the next address within the database. Similarly, the command number within the message may represent a read or request operation, in response to which, the corresponding case would direct the command server to read the desired information from the database corresponding to the user ID transmitted within the message. The command server thereafter adds this data to the message and retransmits it to the communications server.

From the foregoing it will be seen that this invention is one well adapted to attain all ends and objects hereinabove set forth together with the other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

Since many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings **1–19** is to be interpreted as illustrative, and not in a limiting sense.

The following appendix sets forth descriptions of the modules and functions used by the present system.

Glossary

key—an area of the screen that has been registered with the opening system as an area where an event is expected. If an event does not occur within this area, an integer identifier will be returned by the operating system indicating that the event did occur.

event—the screen was touched, if it was touched in an area defined by a key, then return the identifier.

scrolling text window—a key where scrolling text will reside.

scroller—a key associated with the scrolling text window, the scroller has a bar in it to indicate where the text within the text window is in relationship to the rest of the text.

scrollbar—the tool used for entering vitals (darkened from the very bottom of the key to the value chosen by the user).

rolling key—a key with a digit in it, when the key is touched, that digit is incremented. If the digits value is 9 and it is incremented, it will contain the value 0 with no carry performed.

Module

scrollbar.c—contains all functions for the scroll bar functions to be used by other modules.

init_scroll_bar—initializes all necessary variables and draws all of the detail.

get_scroll_bar_value—upon an event in the scroll bar key, this routine is called and it handles that event, then it returns the value that the scroll_bar is pointing to (the value point pointed to by the user).

set_scroll_bar_value—the user can set the value anytime.

functions to be used internally by this module draw scroll_bar—draws the inside of the scroll_bar.

Module

vital_input—contains all the functions used to perform the vital input note—the Mode value indicates what is being input at the moment, if the user has chosen systolic, then the systolic rolling keys are inverted and activated, and the scroll bar will have the systolic data in it.

possible modes—systolic, diastolic, pulse, temperature, respiratory.

Write_Keys_Data—this routine redraws the rolling keys associated with a certain mode, (example, if the mode is pulse and the user somehow changes the value, this routine draws the 100s value in the leftmost key, the 10s value in the middle key, and the Is value in the rightmost key):

ChangeMode -changes the mode of the screen, this involves (1) turning off the old mode (example—pulse); (2) turning on the rolling keys of the new mode (example—systolic) so now an event may occur—also invert the keys so that they are white on black; and (3) calling Init_scroll_bar to redraw the scroll bar with the new modes details.

EnterVitalsDraw—draw the detail on the entire screen

(1) write patients name

(2) write last date and time that the vitals were entered

(3) write the last vitals values

(4) turn off all rolling keys

(5) change the mode to systolic by calling changemode

inc_value—increment the values in the rolling keys, then call Write-Keys_data. inc_temp—same as inc_value, but allow the 100's key to contain the values 0, 1, 2, 3, 4, 5, 6, 7, 8,9, 10, 11.

Do_vital_input—THE MAIN ROUTINE

(1) calls EnterVitalDraw

(2) contains the case statement that handles events.

Module

graph.c —draws the graph on the screen.

make_graph—receives x, y values, x axis label, y axis label, the type of data that the x and y values are (time, short int, int, long int, float, etc.) and draws the graph, depending upon the type of data in x and y, it calls a simple routine that turns the x, y values into x, y plotting points on the screen.

Module

patinput.c—contains all of the functions used to pick a patient.

DoPatientInput—does the entire screens functionality within this one routine.

1-init_scroller—passes in the patient list and the two keys (scroller key and scrolling text key).

2-handles all events. events

in the case that the user picks A–Z, that letter is concatenated onto the search string which is initially empty, then a sequential search upon the text strings is performed to find the first text which is greater in alphabetical value than the search string, then that value is chosen via the function set_scroller_value.

in the event the user touches the scroller then get_scroller_value is called.

in the event the user touches the scrolling text key, then get_scroll_text value is called.

Module

vital_1.c—the starting point of the program contains all function calls.

note—Every single "screen" that is called from any other "screen" will be associated by a Calling Identifier (Call ID).

DoMainMenu—two main case statement

case statement #1

handles the events of the main menu, if an event occurs in any of the keys of the main menu, then store the CallID in the variable called ReturnCode.

case statement #2

while ReturnCode is not equal to 0 loop the case statement. since the, ReturnCode is not 0, call the appropriate function associated with the Calling Identifier stored in the variable, the function called will eventually return a code that will again be stored in the variable RetCode.

Module

scroller.c—contains all functions for the scrolling text windows. functions to be used by other modules

init_scroller—initializes all necessary variables and draws of all the detail.

get_scroller_value—upon an event in the scroller key, this routine is called and it handles that event, then it returns the value that the scroller is pointing to (in our

program, this value is the index into an array of strings—points to the text that was picked).

set-scroller_value—the user can set the value an y time

get_scroll_text value—upon an event in the scroll text window, this routine is called and it handles that event, then it returns the same value as does the get_scroller_value function. functions to be used internally by this module

draw_scroller—draws the bar inside of the scroller, then calls draw_scroll_text.

draw_scroll—text—draws all of the text that appear s in the scrolling text window.

invert_picked_text—inverts the text that is being pointed to by the user.

Major Functions

open_ir—used t o initial the IR communication with the AndroDat Card and setup the communication channels with each device.

close_ir—used to close all communication channels with the hand held.

init_corn_info—used to reset and clear all data contained for one specified com)info buffer. This routine is called initially to initialize each buffer and ready to receive data. After a message has been received and put on the process queue, this routine is used to clear the old data and ready the input buffer for the next command.

collect_messages—this routine will read through each input channel to see if a message exists. If one exists, then the message will be read into a temporary buffer and passed to the routine place_message for placement on the input buffer .

place_message—this routine will determine if the message being read is the first or subsequent message. If the message is the first packet, then the routine parse_long_hdr is called. If the packet is the second or subsequent message, the routine parse_short_hdr is called.

parse_short_hdr—this routine is used to parse the structure tmp_buffer, validate the command being sent along with the correct packet number, then place the data in the appropriate in_buffer message structure. This routine is called after the initial command packet is sent.

parse_long_hdr—this routine is used to parse the structure tmp-buffer, validate the command being sent. This routine then initializes the in buffer structure and finally places the data in the in_buffer messages structure. This routine is called when a handheld device sends its initial packet for requesting a command.

comm_server—this routine is the main routine which controls the logic flow of the entry communication server system.

process_in_buffer—this routine is used to search the in-buffer for completed messages to be placed on the process queue. This routine determines if a message is finished if msg_total=—msg_len and msg_total>0. This routine calls ENQUEUE to physically put the message on the process queue.

process_cmd—this routine is used to take the next message off the command queue then send it to the correct server for processing. This routine calls the dequeue function to physically dequeue the item off the command queue.

process_transmit—this routine is used to take the next message off the transmit queue then send it to the correct server for processing. This routine calls the dequeue function to physically dequeue the item off the transmit queue.

packet_msg—this routine is used to physically send the message from the communication server to the handheld computer via the AndroDat Card. It is responsible for all packets of the data and verify of successful transmission.

enqueue—this routine takes completed messages and places them on the queue. A parameter is passed to which queue to place the message along with the data to queue.

dequeue—this routine will take messages off the queue and place them in a temporary buffer to be processed by the communication server. A parameter is passed to which queue to process along with the temporary space to put message.

nulqueue—this routine is used to initialize a queue and prepare it to start receiving data. Call to this routine will destroy any data existing in the queue.

com_info—this structure is used to store the incoming message from the handheld in_buffer—this is an array of the structure com_info. This structure is used to hold the individual messages being received from the handheld computers.

message_list—this structure is used to serve as the queuing functions for the command processing and data transmission.

long_hdr—this is the structure of the header for initial communication to the server.

short_hdr—this is the structure for second and subsequent communications of the second command.

What is claimed is:

1. A data acquisition and management system comprising:

at least two input computers, operably coupled via a communication link, each coupled to a respective local database of data records; and

at least two portable computing devices, each operably coupled to one of the two input computers via a wireless communication channel for accessing and updating the data records of the local databases of the at least two input computers, wherein each portable computing device comprises:

a CPU for controlling operation of the portable computing device;

memory storing at least one data set, each data set having multiple data fields storing data values; and

a touch sensitive display device for displaying at least a data I/O screen and for sensing contact by a user, the CPU defining multiple virtual regions upon the data I/O screen, each virtual region corresponding to a data field, the display device sensing contact by the user within a virtual region, the display device displaying within each virtual region a data value for the associated data field from a current data set, the CPU identifying a virtual region contacted by the user and executing a control sequence associated therewith.

2. The data acquisition and management system of claim 1, wherein each portable unit has an integrated code reader for data entry.

3. The data acquisition and management system of claim 2, wherein the data comprises in formation related a medical patient.

4. The data acquisition and management system of claim 3, wherein the data comprises one of personal information gathered upon admittance for care, information related to past medical history of the medical patient, and information related to vital statistics of the medical patient.

5. The data acquisition and management system of claim 4, wherein the vital statistics include one of systolic, diastolic, pulse, temperature and respiratory information.

6. The data acquisition and management system of claim 2, wherein the code reader comprises an optical bar code reader.

7. The data acquisition and management system of claim 2, wherein the data comprises product information.

8. The data acquisition and management system of claim 2, wherein the data comprises information identifying a medical patient.

9. The data acquisition and management system of claim 1, wherein each input computer comprises:

a first server that manages the local database coupled thereto; and

a second server for receiving and transmitting packets of information to and from at least one portable unit over the respective wireless communication channels.

10. The data acquisition and management system of claim 9, wherein the at least two input computers are part of a computing tier comprising:

a plurality of first servers for managing local databases coupled thereto;

a plurality of second servers for receiving and transmitting packets of information to and from portable computers, wherein a given second server selectively communicates with portable computers located within a predefined region proximate thereto;

wherein the plurality of first servers and the plurality of second servers communicate with one another via a communications network.

11. The data acquisition and management system of claim 10,

wherein a given second server is associated with one of the plurality of first servers;

wherein the given second server interacts with a given portable computer located with a predefined region proximate thereto to service requests communicated from the given portable computer; and

wherein, upon determining that one of said requests requires access to data stored in a local database associated with a first server other than the one first server, the one request is communicated over the communications network to the other first server to access said data stored in the local database coupled thereto, and said data is returned to the given second server over the communications network for communication to the given portable computer.

12. The data acquisition and management system of claim 10, wherein the plurality of second servers and the communications network therebetween enables communication of data between portable computers.

13. The data acquisition and management system of claim 10, wherein communication between a given second server and each portable computer is selected based on the predefined region and position of the portable computer.

14. The data acquisition and management system of claim 1, wherein the CPU of each portable unit executes a graphical user interface that includes an event handler, the event handler:

identifying one of the virtual regions that corresponds to the location of user contact,

determining a specific event identifier corresponding to the identified virtual region, and

processing a predetermined sequence for the specific event identifier.

15. The data acquisition and management system of claim 14, wherein each virtual region corresponds to a predefined processing sequence which is initiated by the user by contacting the associated virtual region.

16. The data acquisition and management system of claim 15, wherein the predefined processing sequence involves one of a data entry operation, a data transmit operation that communicates data stored thereto to another computing device, and a code scan operation for data.

17. The data acquisition and management system of claim 14, wherein the graphical user interface further comprises a virtual keypad displayed on the data I/O screen for entering symbols associated with keys of the keypad.

18. The data acquisition and management system of claim 14, wherein the graphical user interface further comprises at least one scroll bar displayed on the data I/O screen.

19. The data acquisition and management system of claim 14, wherein the graphical user interface further comprises at least one scroll bar format and a rolling key format.

20. The data acquisition and management system of claim 14, wherein the graphical user interface further comprises a menu screen and a graphing screen, wherein each selection from the menu screen corresponds to a virtual region and an associated processing sequence.

21. The data acquisition and management system of claim 21, wherein the graphical user interface displays multiple icons.

22. The data acquisition and management system of claim 14, wherein the graphical user interface comprises a text input mechanism that enables the user to enter at least a portion of a desired text data, that automatically searches data stored in memory to retrieve text data closest to the portion of desired text data entered, and displays the retrieved text data on the data I/O screen.

23. The data acquisition and management system of claim 1, wherein each portable unit comprises a message notification mechanism that notifies the user of receipt of a message from one of the input computers over the respective wireless communication channels.

24. The data acquisition and management system of claim 23, wherein the message notification mechanism generates one of an audio signal, video signal and vibration signal.

25. The data acquisition and management system of claim 1, wherein communication of data between the at least two portable units occurs over the respective wireless communication channels and the communication link operably coupling the two input computers.

26. The data acquisition and management system of claim 1, wherein each portable unit comprises local memory storing information loaded from the data records of at least one of the local databases via the respective wireless communication channels.

27. The data acquisition and management system of claim 1, wherein each portable unit comprises graphical user interface for interacting with a user to enter user-supplied information, wherein the user-supplied information is communicated to at least one of the input computers over the respective wireless communication channels for storage in the local database coupled thereto.

* * * * *

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United States Patent [19]

Hollenberg

[11] **Patent Number: 6,091,956**

[45] **Date of Patent: Jul. 18, 2000**

[54] **SITUATION INFORMATION SYSTEM**

[76] Inventor: **Dennis D. Hollenberg**, 364 Franklin La., Ventura, Calif. 93001

[21] Appl. No.: **08/873,965**

[22] Filed: **Jun. 12, 1997**

[51] **Int. Cl.**[7] **H04Q 7/20**

[52] **U.S. Cl.** **455/456**; 455/566; 455/557

[58] **Field of Search** 455/432, 433, 455/435, 456, 556, 557, 558, 566, 12.1; 342/357, 454, 457; 340/825.47, 311.1, 905

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Primary Examiner—Nguyen Vo

Assistant Examiner—Sam Bhattacharya

[57] **ABSTRACT**

A wireless system for providing services and time-critical information about places and events to mobile computers and their users proximate to their current locations or potential destinations within enclosed areas, urban landscapes, and open areas, including travel distances and transit times, entertainment, merchants' messages, area attractions, communications, current locations of system users, and traffic congestion information and user-generated information from bar-coded objects and digital photographs of scenes and other materials. Included is a combination low-radiation dosage-reception handset for wireless communications which includes bar-code reader and digital camera peripheral devices for mobile computers, a bracket for interfacing a mobile computer with radio to external systems, and methods for improving the operations of computer reception, search, and display of such information for the edification, efficiency, and enjoyment of computer users.

15 Claims, 9 Drawing Sheets

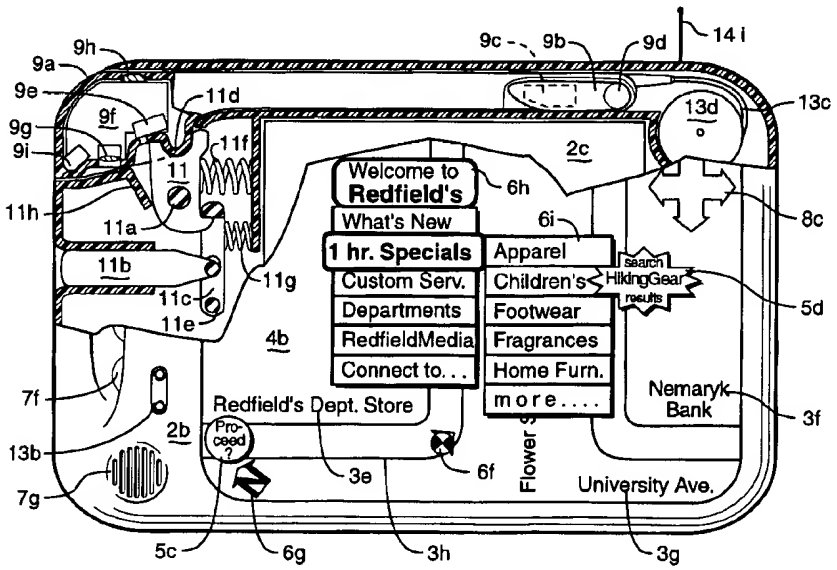
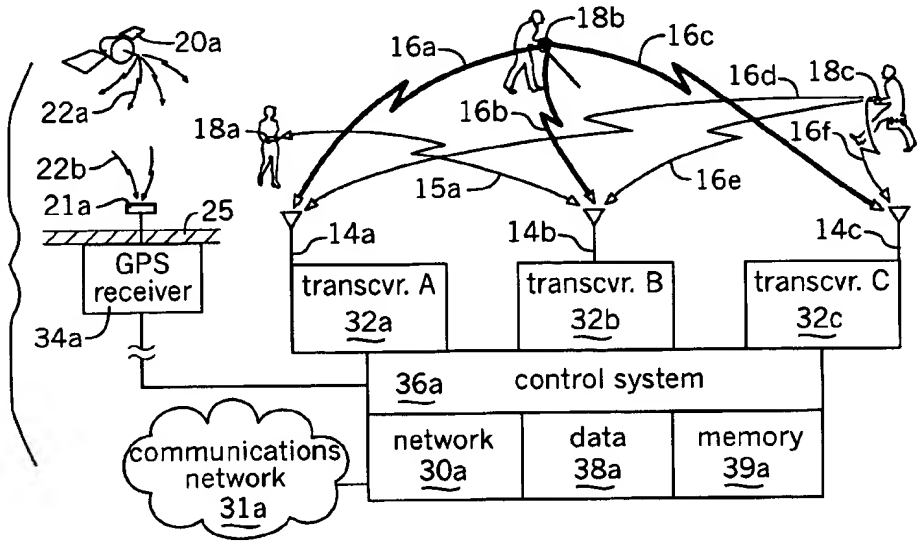


Fig. 1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21a
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16c
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16e
14a
14b
14c
transcvr. A 32a
transcvr. B 32b
transcvr. C 32c
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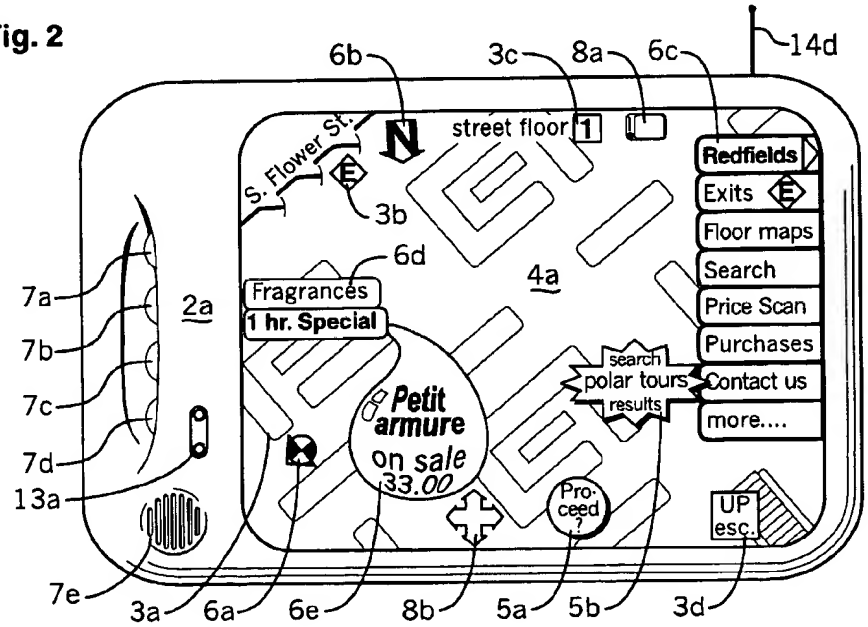
network 30a
data 38a
memory 39a
communications network 31a

Fig. 2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8a
6c
14d
S. Flower St.
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3b
6d
4a
Fragrances
1 hr. Special
Petit armure on sale 33.00
Redfields
Exits
Floor maps
Search
Price Scan
Purchases
search polar tours results
Contact us
more....
Pro-ceed ?
UP esc
7a
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13a
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3a
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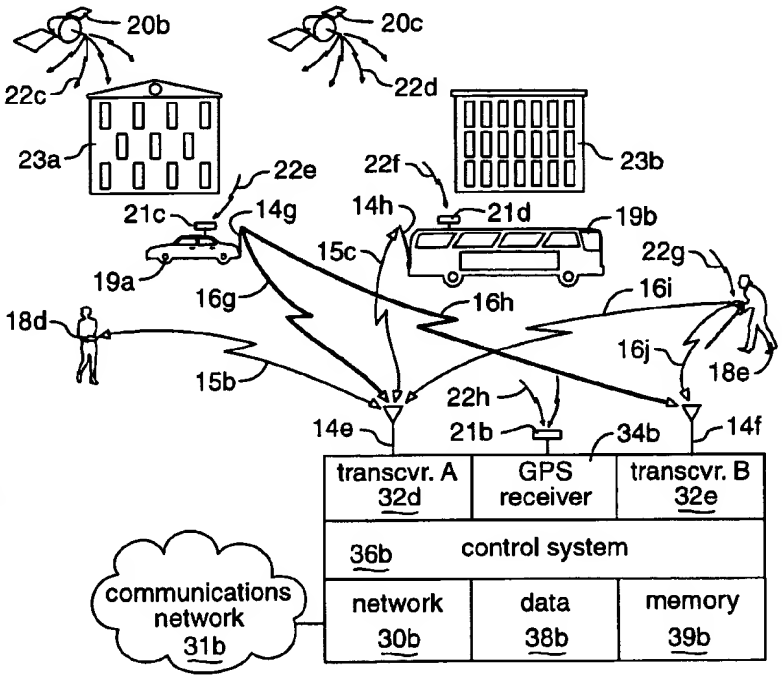
5b
3d

Fig. 3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16g
16h
16i
18d
16j
18e
15b
22h
14e
21b
34b
14f
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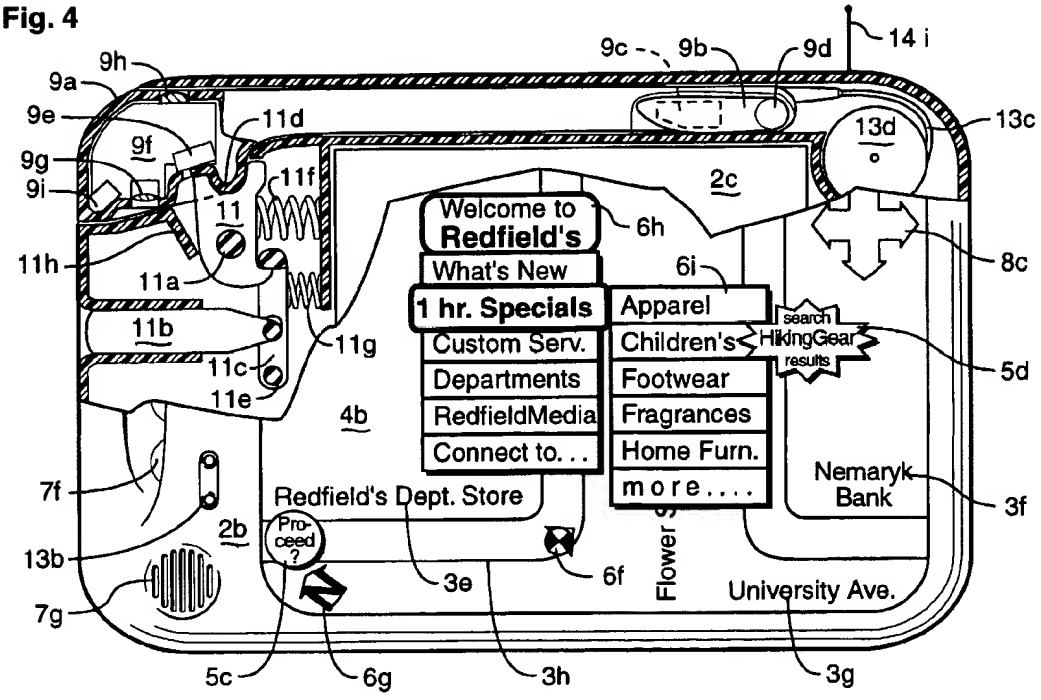
GPS receiver
transcvr. B 32e
36b
control system
communications network 31b
network 30b
data 38b
memory 39b

Fig. 4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9b
9d
14 i
13d
13c
2c
8c
Welcome to Redfield's
6h
What's New
1 hr. Specials
Custom Serv.
Departments
RedfieldMedia
Connect to...
6i
Apparel
Children's
Footwear
Fragrances
Home Furn.
more....
search HikingGear results
5d
4b
7f
2b
13b
7g
Redfield's Dept. Store
Pro-ceed ?
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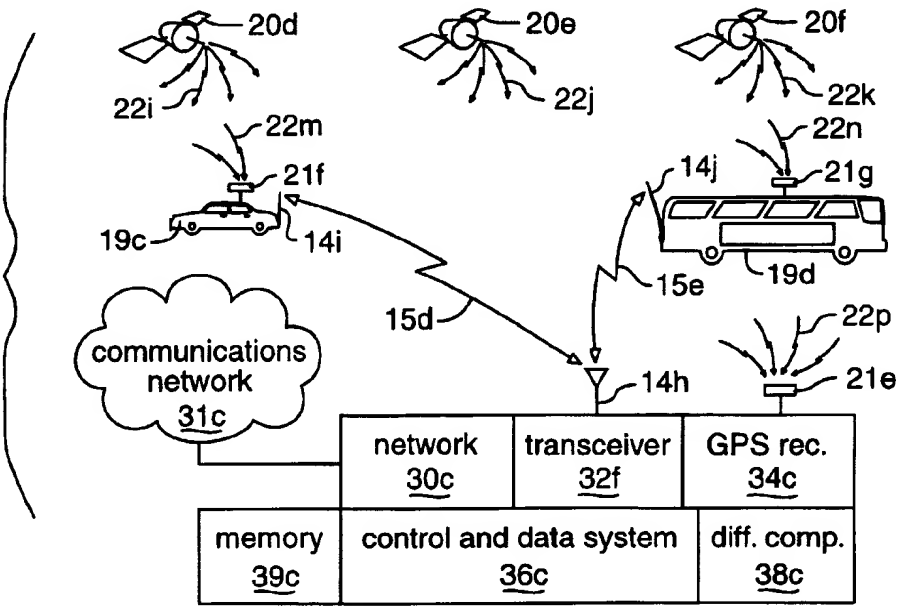
6f
Flower
Nemaryk Bank
3f
University Ave.
5c
6g
3h
3g

Fig. 5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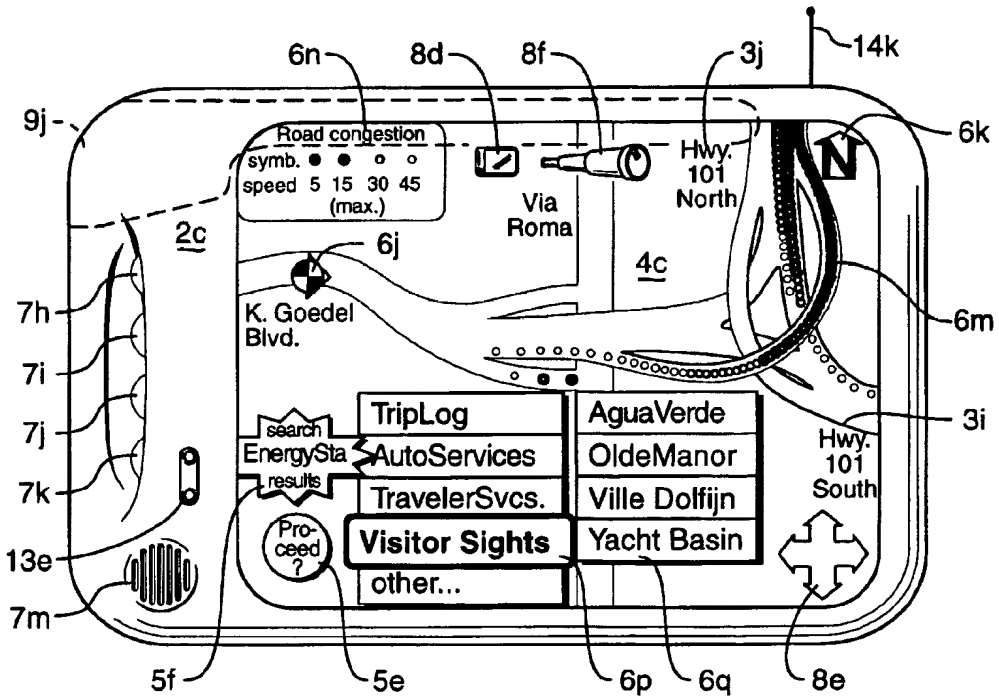
memory 39c
control and data system 36c
diff. comp. 38c

Fig. 6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6j
4c
7h
K. Goedel Blvd.
6m
7i
7j
3i
search
EnergySta
results
TripLog
AutoServices
TravelerSvcs.
Visitor Sights
other...
AguaVerde
OldeManor
Ville Dolfijn
Yacht Basin
Hwy. 101 South
7k
Pro-ceed ?
13e
7m
5f
5e
6p
6q
8e

Fig. 7

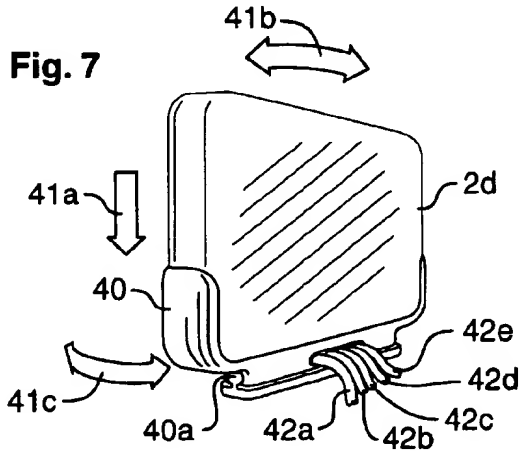


Fig. 8

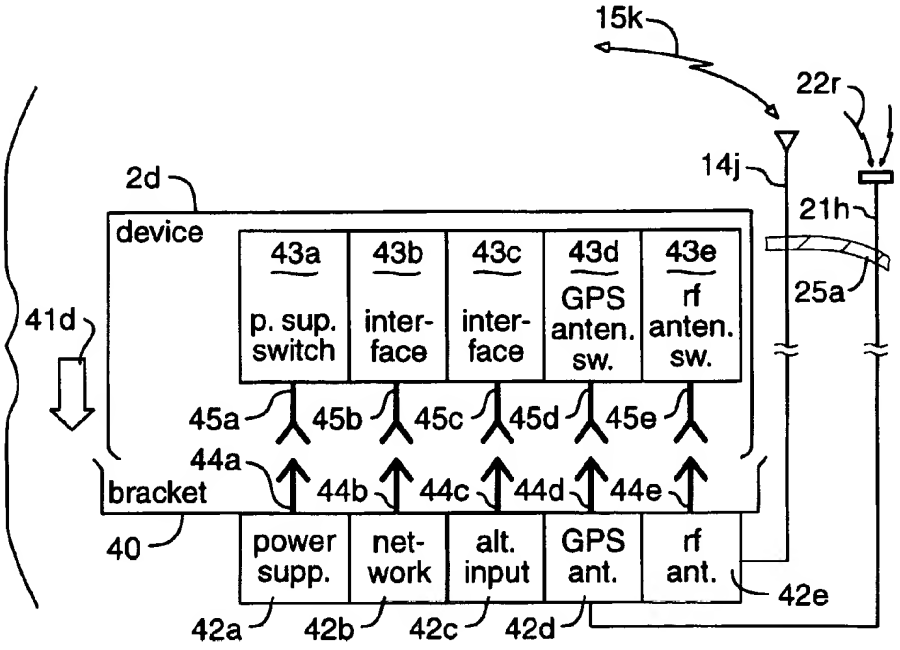


Fig. 9

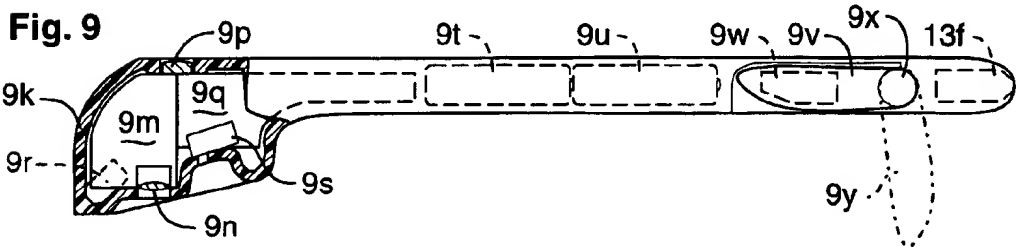


Fig. 10

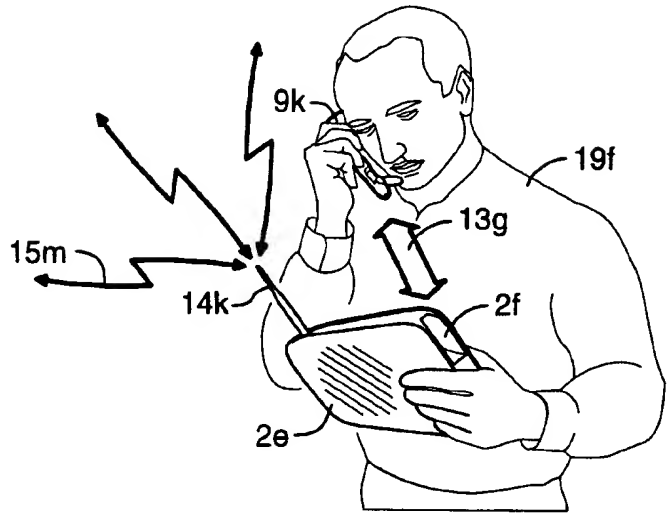


Fig. 11

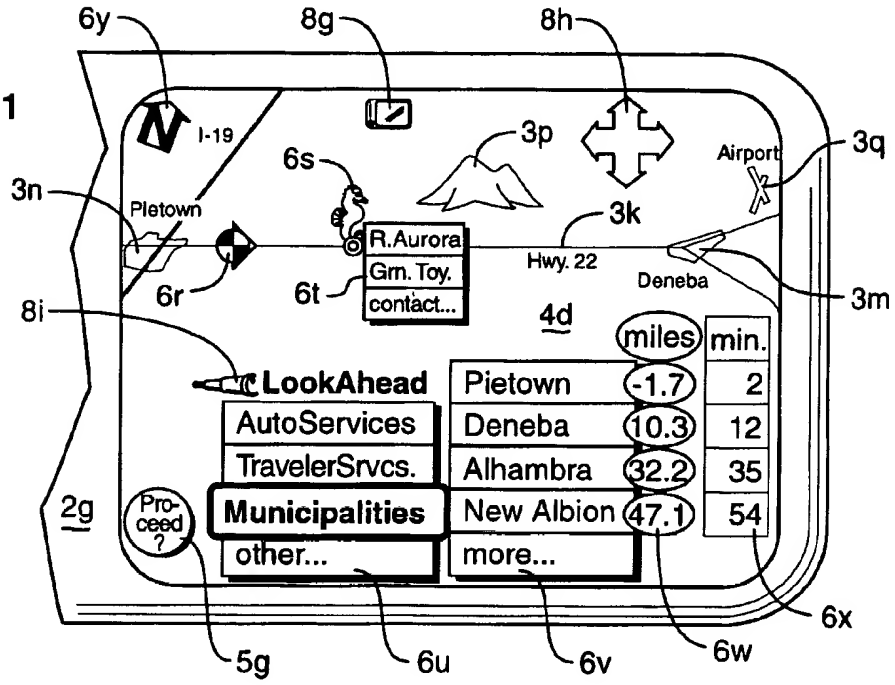


Fig. 12

29 →

item ref. 29a	identifier 29b	location 29c	data type 29d

FIG. 13

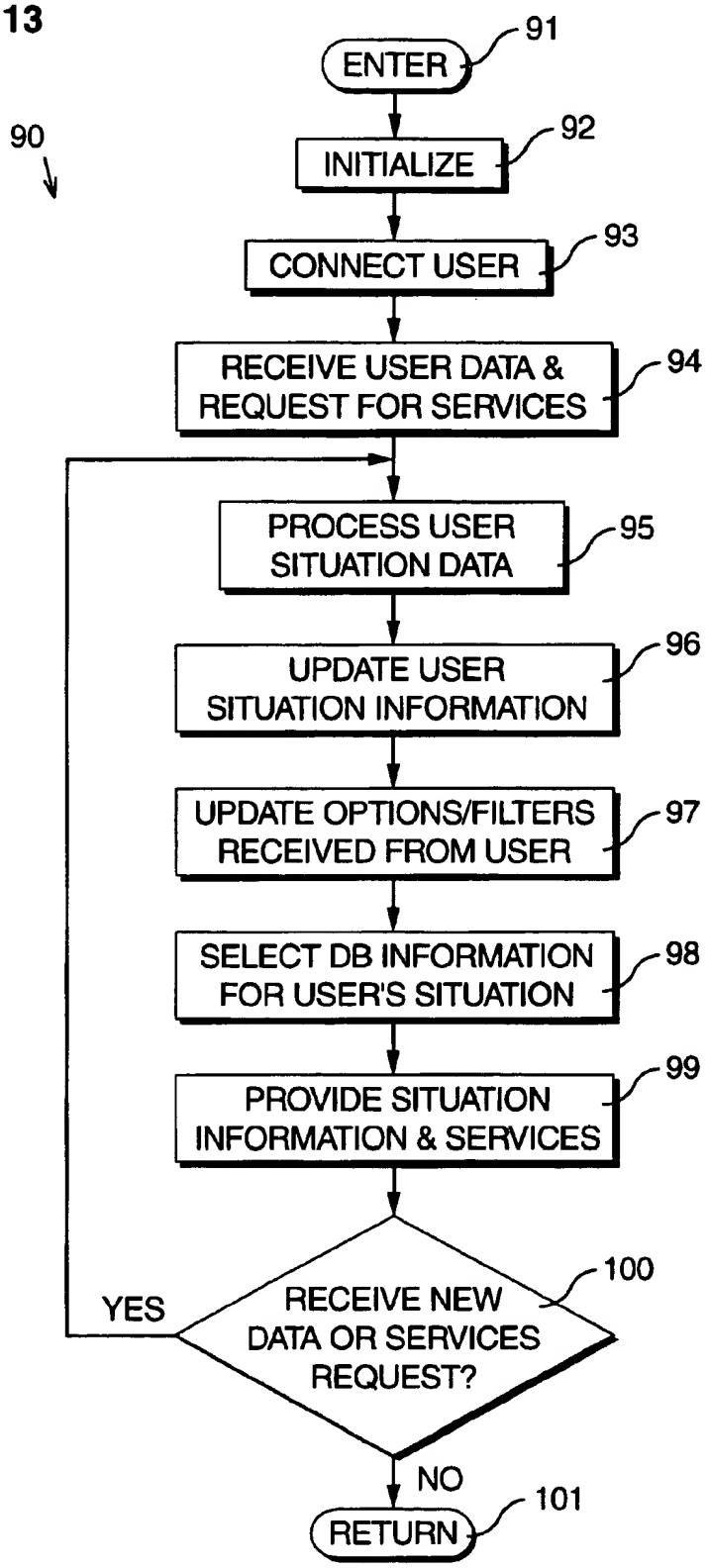

90
ENTER
91
INITIALIZE
92
CONNECT USER
93
RECEIVE USER DATA & REQUEST FOR SERVICES
94
PROCESS USER SITUATION DATA
95
UPDATE USER SITUATION INFORMATION
96
UPDATE OPTIONS/FILTERS RECEIVED FROM USER
97
SELECT DB INFORMATION FOR USER'S SITUATION
98
PROVIDE SITUATION INFORMATION & SERVICES
99
RECEIVE NEW DATA OR SERVICES REQUEST?
100
YES
NO
RETURN
101

FIG. 14

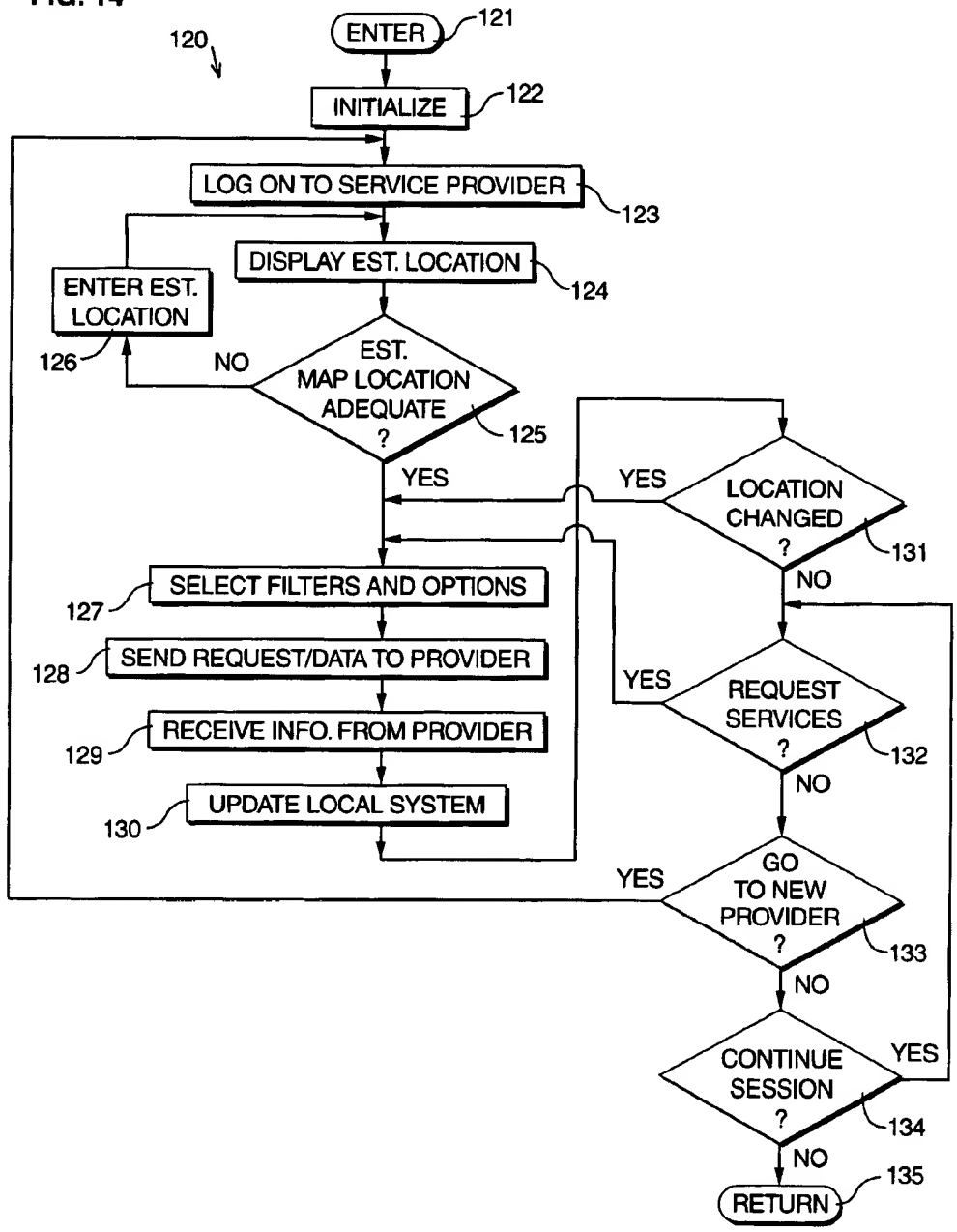

120
ENTER
121
INITIALIZE
122
LOG ON TO SERVICE PROVIDER
123
DISPLAY EST. LOCATION
124
ENTER EST. LOCATION
126
NO
EST. MAP LOCATION ADEQUATE ?
125
YES
YES
LOCATION CHANGED ?
131
NO
SELECT FILTERS AND OPTIONS
127
SEND REQUEST/DATA TO PROVIDER
128
RECEIVE INFO. FROM PROVIDER
129
UPDATE LOCAL SYSTEM
130
YES
REQUEST SERVICES ?
132
NO
YES
GO TO NEW PROVIDER ?
133
NO
CONTINUE SESSION ?
134
YES
NO
RETURN
135

FIG. 15

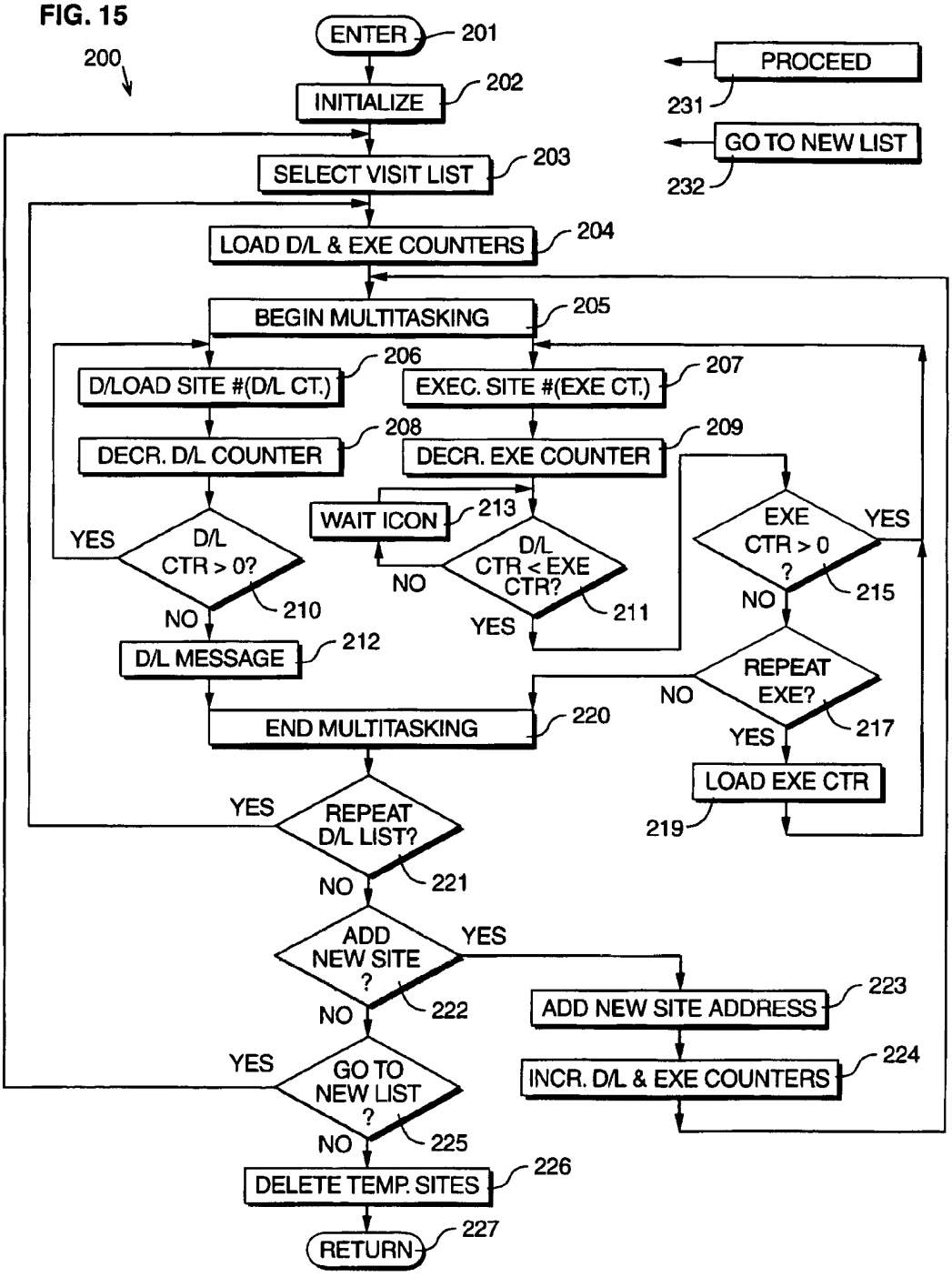
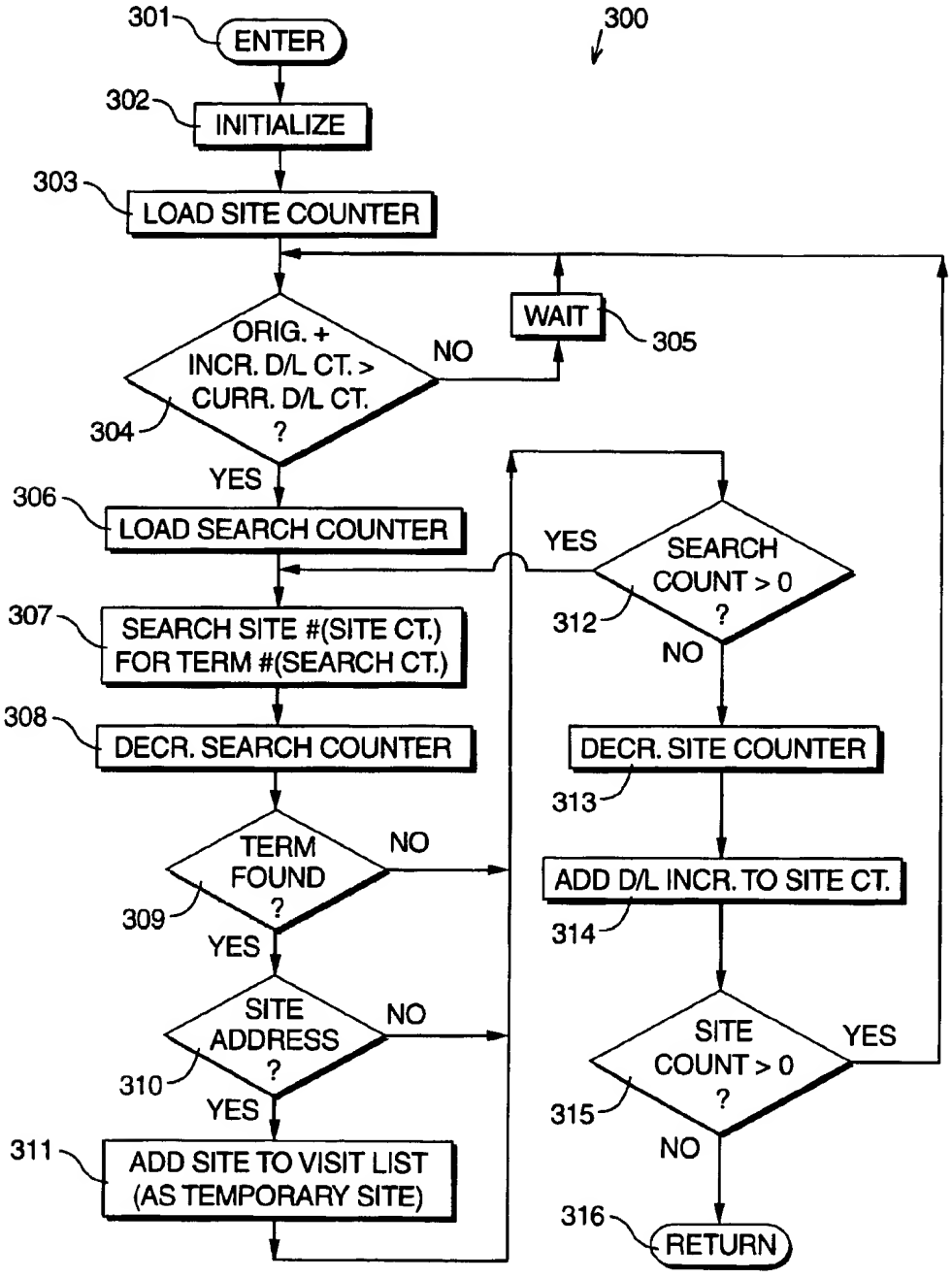

200
ENTER
201
INITIALIZE
202
SELECT VISIT LIST
203
LOAD D/L & EXE COUNTERS
204
BEGIN MULTITASKING
205
D/LOAD SITE #(D/L CT.)
206
EXEC. SITE #(EXE CT.)
207
DECR. D/L COUNTER
208
DECR. EXE COUNTER
209
YES
D/L CTR > 0?
210
NO
D/L MESSAGE
212
WAIT ICON
213
NO
D/L CTR < EXE CTR?
211
YES
EXE CTR > 0 ?
215
YES
NO
REPEAT EXE?
217
NO
YES
LOAD EXE CTR
219
END MULTITASKING
220
YES
REPEAT D/L LIST?
221
NO
ADD NEW SITE ?
222
YES
ADD NEW SITE ADDRESS
223
INCR. D/L & EXE COUNTERS
224
NO
YES
GO TO NEW LIST ?
225
NO
DELETE TEMP. SITES
226
RETURN
227
PROCEED
231
GO TO NEW LIST
232

FIG. 16


300
301
ENTER
302
INITIALIZE
303
LOAD SITE COUNTER
ORIG. + INCR. D/L CT. > CURR. D/L CT. ?
304
NO
WAIT
305
YES
306
LOAD SEARCH COUNTER
307
SEARCH SITE #(SITE CT.) FOR TERM #(SEARCH CT.)
308
DECR. SEARCH COUNTER
TERM FOUND ?
309
NO
YES
SITE ADDRESS ?
310
NO
YES
311
ADD SITE TO VISIT LIST (AS TEMPORARY SITE)
YES
SEARCH COUNT > 0 ?
312
NO
DECR. SITE COUNTER
313
ADD D/L INCR. TO SITE CT.
314
SITE COUNT > 0 ?
315
YES
NO
316
RETURN

SITUATION INFORMATION SYSTEM

BACKGROUND—FIELD OF INVENTION

This invention relates to distributed information systems, specifically those which exchange information about places, their events, and details with mobile computers and their users.

BACKGROUND—GENERAL DISCUSSION

Societal changes, marked by increasingly mobile life styles, greater work demands, and downsizing in business and government, have desocialized public environments by reducing people's free time. A consequence is that the lively marketplace atmosphere that once inspirited our city centers has generally been replaced by inhospitable spaces. For example, in cities only at lunch times do people fill the few open urban spaces to socialize and find diversion before returning to work. Most people in our increasingly connected society require communications access in order to conduct their daily business, access generally unavailable outside of buildings.

Environments providing accessible data communications resources would attract such people regularly since they could continue working on their projects. The presence of these workers would draw other visitors, some of whom might offer products or services or visit because of the interesting assortment of people reliably to be found there. Thus, after providing the seeding effect of appropriate communications services, modern-day marketplaces could again enliven our cities and towns. Such environments would provide a true sense of physical place which the Internet lacks. Businesses, potentially the best providers of such services, can't support them without payback, however.

While people's need for information that specifically fits their needs has increased, the availability, accessibility, and timeliness of this information, about specific places, events, and their details, called situations herein, have decreased. The current population is aging but, at the same time, continues to travel more than those of the past. Everyone, particularly senior citizens, need ready information concerning events, conditions, and services about a place, particularly when it's unfamiliar or one which they are about to visit, to be more secure and better able to enjoy it.

Similarly, people with physical challenges could function more freely in public places with the aid of a system which provided them with a specifically appropriate combination of aural, visual, and tactile information about their location. Having ready access to timely, proximate information, i.e., information particularly relevant to a user's location such as local services information, such as transportation-system routes and schedules identifying nearby stops and other services, would increase their traveling efficiency and safety.

Because people now have less time, shopping is taking a greater proportion of free time. Worsening the problem, many stores are cutting costs by reducing staffing and merchandise inventories. Shoppers searching for price or stock information in a store must now spend more time searching the isles for help in finding the merchandise they seek. Clearly, useful time-critical and specific information about stores' offerings—merchandise information—is increasingly out of reach.

With Internet (via the PC) and TV information competing for audiences, local retail stores increasingly find it expensive and difficult to advertise their inventories to their desired audiences. A system that leads the customer directly

to the offered merchandise, occasionally calling the customer's attention to related or promoted items, would increase that store's sales volume.

In contrast to the diminishing availability of local information, world-wide information via the Internet is burgeoning. While users of the World-wide Web can get information about a specific product in a distant country, information about price and availability of a product at a local store is often frustratingly difficult to get. Once the product is located, the final shopping penalty is the time wasted in the cashier's line.

A partial solution to these problems is the ubiquitous portable telephone. However, the expense for using it for frequent inquiries about services and products would quickly grow exorbitant. An obvious problem, too, is the lack of an accessible and efficient telephone directory or database to quickly connect to the appropriate information source. Product pricing information often requires a bar-code reader, i.e., a device for scanning the bar code, or universal product code (UPC), of a product, which is only available at the cashier's station. Too often such attempts to gain information results in wasted time.

Another problem with portable telephones is their potential for insidiously causing cancer in sensitive organs such as the brain. Because the radio frequency (rf) transmitter and antenna of the wireless telephone is the source of potentially cancer-causing electromagnetic wave radiation (EMWR) and is positioned near the head when the user telephones, the head area receives the highest radiation dose. An additional potential health hazard of such telephones is their suspected interference with cardiac pacemakers.

Lack of timely information about traffic congestion each year can cumulatively amount to several days taken from commuters' lives, as much as two weeks worth of eight-hour days in the largest cities, and, with fewer new highways under construction, the losses can be expected to rise. With better and more timely information about traffic, which includes aircraft, watercraft, etc., some traffic jams could be avoided. However, even after years of existence of the Intelligent Vehicle Highway System initiative, little improvement has been forthcoming. Currently, generally available traffic advisory information is limited to the airborne radio report which only functions after a traffic slowdown happens to be spotted. Any solution to this problem must be cheap, simple, and ubiquitous.

Timely and reproducible information about situations involving criminal acts would serve to reduce their numbers by deterring the perpetrators. For example, if cameras were commonly carried by people, the probability of perpetrators being photographed and identified increases. A digital camera built in to a portable computer device or telephone could share some of the circuitry to reduce the marginal cost of adding it. Such a camera could also serve to record travel scenes, copy documents, and, for the solution to be widely embraced, provide entertainment for users.

Information about places and their events, situation information, helps people to function closer to their potential. Such information resides available, but largely inaccessible because it lies unindexed and distributed in a plethora of largely local repositories. The lack of access to situation information is largely a technological problem the solution for which includes elements of business, the Internet, entertainment, communications, and computer technology. In order for a solution to be workable and universally embraced, it must also be distributed, put into the hands of average people.

BACKGROUND—DISCUSSION OF PRIOR ART

Finding the location of radios, including transmitters and transponders, through various methods including chronometrical, i.e., time measuring, triangulation is well understood. The U.S. Global Positioning by Satellite (GPS) System and the Russian Global Navigation Satellite System (GLONASS), collectively referred to herein as the satellite positioning system or GPS, are comparatively recent permutations of these methods which provide precise time signals for mobile receivers to compute their location. GPS signals are often obscured in environments of hills or tall buildings.

Methods of using rf signals from various sources for location finding are well known. McEwen U.S. Pat. No. 5,589,838 (1996) shows a mobile transmitter emitting pulse groups which are then triangulated by multiple stationary, self-gating pulsing receivers; the receivers must process large data sets in order to resolve each transmitter's location. Jandrell U.S. Pat. No. 5,526,357 (1996) shows a multilaterating communications system using mobile transponders for intercommunication and locating. Duffet-Smith U.S. Pat. No. 5,045,861 (1991) shows a method of determining the location of a roving receiver by way of computing the phase difference of multiple signals from multiple transmitters.

Methods using combinations of satellite and wireless communications for fleet operations include Barzegar et al. U.S. Pat. No. 5,559,520 (1996) which shows a vehicle routing system with GPS and an on-board locator control module with storage which provides modifiable route information, received data with location markers (which term, markers, is neither clear nor defined) and alarms to alert a central dispatcher of deviation from an defined, assigned route. Similarly, Schreder U.S. Pat. No. 5,504,482 (1996) shows a GPS navigation system with complex on-board digital map storage, interfaces to vehicle control systems, route processing to destination, etc. Paul U.S. Pat. No. 5,524,081 (1996) shows a system of GPS-signal-receiving vehicles with preloaded golf-course information and a base station which provides differential location correction and information specific to the vehicle's location on a golf course. However, with thousands of mobile transmitters, such as motor vehicles on crowded freeways, or widely ranging systems traveling to diverse destinations, the forementioned prior art would require unworkably large, difficult to update, on-board locator data modules or data bases. Such systems would suffer from the centralized nature of their information sources and would therefore be subject to complex data processing and data updating burdens which no ordinary user could perform as the logistics would be unworkable.

Other location-related prior art includes Penny, Jr. et al. U.S. Pat. No. 5,414,432 (1995) showing a locating transceiver with GPS optionally included in a portable radio which transmits a rescue message. Simms et al. U.S. Pat. No. 5,334,974 (1994) shows a mobile security system which transmits position information to a central console map and dispatcher for providing emergency service. Finally, Krenzel U.S. Pat. No. 5,124,915 (1992) shows a dedicated emergency information gathering system which provides information to a central analysis location. Such prior art systems address infrequent events as opposed to the need for continuing information flow in many people's daily lives.

Prior art addressing vehicle traffic congestion and navigation includes Sone U.S. Pat. No. 5,313,200 (1994) showing a centralized traffic congestion display system with directional arrows to indicate the location and direction of travel of the congested traffic. Sumner U.S. Pat. No. 5,182,555 (1993) and Sumner U.S. Pat. No. 5,173,691 (1992) show a messaging system and data fusion system, respectively, for an elaborate, centralized traffic congestion information system. Such systems, with their centralized information processing systems, prove expensive to build and maintain and are prone to failure. Barbiaux et al. U.S. Pat. No. 4,804,937 (1989) shows a wireless vehicle monitoring system for fleet operations which provides vehicle operational data to a central database.

Prior art relating to further aspects of subject invention include Montague et al. U.S. Pat. No. 5,504,589 (1996) showing a wireless ordering system for food service applications; Register U.S. Pat. No. 5,465,038 (1995) showing a recharging and data-transfer docking bracket which accepts a handheld computer; Hanson U.S. Pat. No. 5,218,188 (1993) shows a handheld data terminal with the capability to link with an rf communications computer; Kelly et al. U.S. Pat. No. 5,184,314 (1993) showing a mobile data communications terminal with docking bracket for an external antenna and keyboard interface to accept a handheld computer with rf communications capability; Davis U.S. Pat. No. 5,052,943 (1991) showing a recharging and data transfer bracket for receiving an elongate handheld computer; and Girouard et al. U.S. Pat. No. 4,982,346 (1991) which shows a fixed-location kiosk for retail-mall promotion applications. While the subject matter of the latter six prior-art exhibits pertain to aspects of subject invention, none provide the handheld computer and communications characteristics that a time and place-critical information system demands.

SUMMARY OF THE INVENTION

The Situation Information System relates to information communications between sources of timely information and one or more information users which also provide information to other users. Broadly stated, situation information pertains to information about events or conditions associated with places which the mobile user may encounter or consider visiting. It particularly includes events occurring or about to occur in a locus accessible to the mobile user and to which the user may arbitrarily choose to respond by visiting one or more of the events, avoiding them entirely, communicating them to another person, rectifying them, or otherwise modifying plans and itineraries in light of such events. Sources of situation information are databases of local information and information from users themselves. Additionally, the situation information system provides users with up-to-date map-tracking information relating their location to events and situations as well as enabling them to respond in a timely manner.

A comparatively simple area-data communications system operates using high frequencies at sufficiently low power levels to avoid interference with neighboring systems. For example, in substantially enclosed areas a system consisting of multiple transceivers transmit a query signal to mobile transponder devices included in handheld personal computing devices. When the transponder responds with its identification sequence, its location is then computed through chronometric triangulation based upon transponder signal arrival times at the system receivers.

In cities having "urban canyons" formed by tall, close buildings, Global Positioning System (GPS), meaning the global satellite positioning system such as GPS, GLONASS, or other systems, signals are further degraded by multiple-path interference and signal-acquisition failure. In such an environment transponders and receivers could use the rf

signal from a satellite positioning system as a timing signal as the source of a gating pulse or trigger to coordinate their functions. In this mode, upon receipt of the satellite clocking signal, the transponder transmits its signal while, at the same instant, local receivers begin counting in order to quantify the elapsed time preceding their receipt of the transponder signal emitted by the device. Thus, device and transponder location is then calculated chronometrically from the elapsed time, net of internal device delays, etc., at each of multiple triangulating receivers. In these location-finding systems, position resolution to within a few feet is possible in an otherwise obscuring topography.

In the preferred embodiment, a situation information system consists of at least one mobile computer with multiple transmitters and receivers, i.e., radios, a known-location information service provider including one or more radios, accessible network, computer equipment with memory, which term includes storage, drives, and RAM units, and computer programs to provide for efficient situation information exchange between them. The mobile computer's transmitters and receivers include a receiver for satellite positioning system signals, such as GPS or GLONASS, a transceiver for wireless voice and data telecommunications capability, and a transponding transceiver for location finding in topographically complex, that is, mountainous areas or areas surrounded by buildings, e.g., in urban "canyons" and those enclosed within buildings, such as shopping malls.

These radios can be produced in the form of multiple frequency radios to reduce cost and size, by requiring only a single set of components, and function as many different radios depending upon their operating parameters. Alternatively, increasing capacities of the digital signal processor (DSP), currently lead by a chip capable of performing up to 1,600 million instructions per second, augurs the coming of so-called software radios in which virtually all rf processing functions will be performed in solid-state devices such as silicon-on-insulator (SOI) methods. In the next few years wireless telephones with software transceivers appearing on the market will offer selectable protocols and frequencies for GSM, CDMA, PCS, etc. Smart antennas will continue to improve and provide greater selective directionality to further enhance the efficient use of rf spectrum, which, along with the advantages of digital communications, promises to provide an abundance of channel capacity.

One such transceiver of subject invention provides voice communications which, because it is desirable that the form factor of the situation information device provide a usefully large display or graphical display unit (GDU), which term includes all forms of sensory media such as tactile and aural as well as visual, and militates against an integral telephone ear piece or telephone speaker and a telephone mouth piece or telephone microphone, separate the foregoing parts from the rf processing section in the form of a separate handset. The handset, removably stored in or upon the case of the situation information device, contains the aforementioned speaker and microphone components and is connected to the rf section by an extendible cord attached to a reel. The handset may alternately communicate to the radio section of the situation information device by way of a photonic link, which includes an infrared (IR) media link, providing the microphone and speaker signals are appropriately converted by analog-digital and digital-analog techniques, respectively.

Although the small form factor customary of mobile telephones is sacrificed in the aforementioned arrangement, other benefits accrue to users of subject invention. First, because the handset is physically removed from the rf antenna of situation information device when in use, rf or EMW radiation to the head is reduced considerably. By holding the combination display unit and radiative transmitter and antenna away from the body—at arm's length, if convenient—harmful radiation exposure is reduced by at least two orders of magnitude. Radiation intensity varies in inverse proportion to the square of the factor of difference in the distance. Thus, by moving the rf transmitting antenna from about two inches from the brain, as it is in integrated-unit mobile telephones, to twenty inches away, radiation exposure to the organ is reduced to a mere one per cent of the original intensity.

Secondly, to increase the situation information capability of the system, peripheral devices such as a bar-code reader and a digital camera, which term, peripheral devices, also includes keyboards, printers, and other input/output equipment. The digital camera, because of the decreasing size of its components, for example, the lens and the resulting tiny aperture, can serve to copy documents and can be fit into the handset. In such a configuration, these peripheral devices can share electronic components such as computer central processing unit, DSP unit, memory, storage, and rf units, as appropriate, to avoid cost and space requirements of their duplication. Included also is a wireless, meaning all photonic media such as infrared, data interface for wirelessly connecting to peripheral devices, including the aforementioned handset, or suitably equipped computers such as the desktop personal computer (PC).

Subject invention would prove useful to, for example, visitors driving into an unfamiliar city. They would want to know about hotel accommodations and restaurant offerings in the city as they approached it. While reviewing the hotel situation information, for example, their electronic map would show traffic congestion forming in their path and they may choose to take a more immediate exit in order to avoid congestion. They would review hotels having vacancies and special offers in their price range and negotiate reservations by telephone or electronic mail (e-mail). Additionally, the visitors could arrange their stay's agenda by reviewing the area's attractions and entertainment offerings while homing in on their chosen hotel using the digital map which would show their position relative to their goal. As they approached their hotel, the map display would zoom in to reveal increasing detail, ultimately positioning them at the hotel's entrance. Upon their arrival and because the staff, using their hotel computer, would be able to monitor the visitors' progress, the visitors could be greeted by name.

Removed from its bracket mounted inside their automobile, the visitors could carry their situation information device with them as they explore the city on foot and use it to learn about the city as they approach historical sites and attractions. While visiting a department store, one visitor could take a digital photograph of the other modeling a potential clothing purchase using the camera built into their situation information device. The trial fitting and photographing might continue at other stores so that the fit of the clothes from different stores can be viewed on the display and compared later. Next they might visit an attraction in the area such as a zoo or wildlife preserve and use the bar-code reader built into their situation information device to search and receive additional information about plants, animals, environments, and histories of specimens they encounter. Similarly, they could enter and record the organisms' names and natural histories into their device as they photograph them.

The same visitors the following day at the department store could use their situation information device to search the store's gift suggestions to choose presents to give to their grandchildren upon their return home. Their indicated position, which is conveniently tracked for them on the store's floor plan shown on their display, would speed them on their way to the various items they've selected for viewing. The bar codes of those items selected could then be scanned into their device, as well as that of the chosen clothing article, and, with their charge-card information transmitted automatically to the store's system and verified, the transaction could be completed with dispatch.

Such a system, which allows the store to provide its information and message to potential customers who are opportunely traveling nearby, stands a better chance of enticing them to visit: getting a customer who is driving along a nearby street into the store is easier than motivating him or her to leave home or work, get in the car, endure traffic, find parking, etc.

Further, a networked store could benefit by directing employees' activities to more profitable tasks like providing better customer service, for example. Extending the idea further, a customer possessing a device with a communication link to information from the store's product database, a terminal device for querying the database, and a bar-code reader, could shop for merchandise without the assistance of store personnel. With appropriate prior credit arrangements, the shopper could collect and price his or her merchandise, electronically execute the charge instrument for the purchased items, and exit.

In such a scenario, a local extranet and customer-carried display device could provide a new type of promotion and advertising medium. For example, knowing a person's location, the networked store could increase customer traffic by transmitting special offers directly to the willing customer's device. An additional benefit is that customers can receive services like maps and other aids to help them find their way around the store or shopping mall to the desired merchandise or store, respectively.

Situation information devices could also provide additional digital information services such as electronic mail, entertainment, games, news, television, particularly digital TV, and access to other networks, including the Internet, for example. The requisite services could also be provided by a store, a restaurant, or a shopping district association to promote a steady clientele.

Subject invention also a provides a resource for foreign or physically impaired visitors who lose their way in an area without situation information services is a device with which they could transmit a digital photograph of their location to local authorities who, after identifying their location, could orient them. Alternatively, the posts of street signs could carry an appropriately located bar code label which, when scanned with a bar-code reader, would instantly reveal the reader's location and the names of nearby streets, etc. A mobile computer and wireless telephone with peripheral devices built-in, such as a telephone handset, a digital camera, and a bar-code reader would enhance visitors' exploration and enjoyment of an area.

With camera and bar-code reader combined with the telephone handset, users would require a single element to perform all three functions. Also, many of the same electronic components could provide function to each of the peripheral devices, for example, the digital computer could provide much of the digital processing for the peripheral devices. The housing of a usefully large display could also provide convenient attachment for the removable telephone handset with integral camera and bar-code reader. Further, the radio transmitter section of the wireless telephone could be separated and located within the display section; the transmitter would then communicate with the handset through retractable wire or a wireless link such as infrared.

Area services and public safety personnel could do their jobs faster and more effectively with a ready source of situation information at their fingertips. For example, traffic congestion and emergency-situation information can be provided to approaching motorists and distant emergency decision makers, respectively, by those on the scene equipped with camera and communication capabilities. Digital photographs or video recordings of the scene could be quickly transmitted to those who evaluate emergency-situation information. In the case of vehicular traffic congestion, the vehicle's location, speed, and travel-direction data could be collected and redistributed as real-time, graphical, traffic-situation information. Thus, vehicle operators could avoid traffic situations that lay in their paths. Motorists encountering accidents could transmit digital photographs to the emergency-response dispatch center. Accident victims could also record traffic-accident details, drivers involved, drivers' identification, license-plate numbers, etc., as corroborating visual information.

In yet another embodiment of subject invention the situation information device would connect to external systems, that is, systems which are substantially external to the situation information device, such as electrical power from the vehicle's electrical system, exterior antennas, vehicle digital network, and other peripheral devices like a keyboard. For example, after driving to the shopping area users connect to peripheral devices enabling them to send and receive e-mail, print files, etc.

In yet another embodiment of subject invention is a distributed system of information service providers which provide data about geographical features, services, and attractions in their local area and transmit that data to mobile devices for display. Data such as mileage to various municipalities, services, and attractions using a location-specific information sequence for fast transmission to mobile devices which display the mapped information, compute distances from the mobile device's current position, etc. Each feature is identified by a code or byte sequence containing fields for the name, global location, and if applicable, Universal Resource Locator (URL), as well as variables for formatting and graphical symbol to be displayed or otherwise executed, aurally, for example. In operating such a system, users of mobile devices with narrow bandwidth, i.e., slow communications devices, could receive the important subset of mapping elements for a given area quickly. For example, they could receive elements such as main roads and cities and the separation, i.e., mileages and transit time, between them with which their mobile device could compute their mileage and the estimated time before arriving. Also, the mobile device itself could store standard graphical symbols for even more rapid display of such map features in the locations specified by the downloaded mapping information. Devices could then download additional information, including detailed maps, from the information provider should that be required.

Objects and Advantages of the situation information system:

- a system for providing mobile users with time-critical situation information.
- a system for providing mobile users with geographic location information, such as corrected by differential GPS.

a system for providing mobile users with a multiple-function device to generate time-critical situation information, such as that pertaining to traffic congestion, events, and emergencies, for themselves or for others at other locations.

a system for providing situation information, such as area maps, other users' current locations superimposed on an area map, and transportation schedules, to enhance the efficient mobility of the physically impaired and others.

a situation information system which provides local or proximate information, such as merchant's advertising messages, merchandise offers, and tourism site information, according to mobile users' location.

an information system with which a shopper can better serve himself or herself by, for example, determining product availability by querying a store's inventory, determining the price of products using a handheld multiple-use electronic device which includes a bar-code reading device, and electronically paying for the selected merchandise without requiring assistance from store personnel.

a system for merchants, acting on a short-term basis, to communicate special offers to customers in order to increase store traffic, reduce inventory, and increase sales.

a system for collecting a facsimile of local situation information, such as a local scene, printed materials, or graphical information, using a multiple function system which includes a digital camera.

a system in which bar-code information posted in various places in an area, one without other available locating means, is used to orient visitors to the area and aid in determining their location.

a system for providing situation information produced by a digital camera and bar-code reading device transmitted by a wireless transceiver for displaying on the user's graphical display or communicating to another device.

a system for generating situation information for vehicles derived from GPS or other peripheral device for transmission to another user for displaying on an associated graphical display.

a system for locating a transponder using a satellite positioning system time signal as gating pulse for subsequent position determination by other receivers.

a situation-information collecting and processing device for use in a vehicle which can be detached from the vehicle's systems and operated by a pedestrian user.

60 a system for providing situation information received from a wireless telephone with its antenna and transceiver mounted in a handheld computer and display unit and the telephone's microphone and speaker mounted in a separate, but communicatively linked, handset unit with other peripheral devices such as a digitally copying camera device and bar-code reading device.

a computer system which includes a wireless telecommunications device, the handset of which is separate from the rf transceiver and can be securely attached to the computer device when not being used.

a distributed information system for mobile users which provides local area information, for example, map, travelers' services, and geographical features information, in a concise form suitable for rapid download and display on the user's mobile device.

a mobile information system with which users could represent themselves on other user's computer displays with graphical symbols which could also be executable computer code to provide animation, sound, etc.

a wireless telephone that greatly reduces radiation exposure to the user's head area consisting of a handset, which encompasses the telephone microphone, speaker, and appropriate electronics circuitry, spatially separate from but communicatively linked to its rf transceiver by a retractable cord or infrared (IR) transceivers.

a situation information system which automatically and serially downloads from one or more selectable lists of one or more information sources or sites into memory, including storage, for viewing on later demand concurrently with the user employing information, for example, by viewing or hearing, from a previously downloaded site.

an on-line information system in which users' customary information-source selections, such as electronically accessed sites catalogued on one or more visit lists, are automatically retrieved while the user is using or viewing information from a site downloaded earlier in the session.

an on-line information search system in which users' interests, entered as lists of keywords or search terms, are automatically searched for their occurrence on each site serially downloaded from visit lists, and sites containing keywords are themselves automatically downloaded, while the user is using or viewing information from a site downloaded earlier in the session.

a mobile on-line information system in which a user can select geographically ordered information sources, which are advanced from the user's current location and have no other relationship to it, and choose to visit on the basis of the current events at that location.

an on-line system providing users with a method of locating one another in an area through the use of unique user location and direction symbols.

an on-line system that provides a sense of place in contrast to the Internet's abstract nature and lack of physicality.

DRAWING FIGURES

The breadth of the situation information system is reflected in the many possible embodiments which take their form in various parts and arrangements of parts. The following drawings are provided for the purpose of illustrating its many aspects and embodiments and should not to be construed in any way as limiting.

FIG. **1** is a diagram of the main components of a wireless situation information system for physicallt defined environments such as shopping areas.

FIG. **2** is a diagram of a basic situation information device with graphical display showing an exemplary retail-store floor plan and other graphical situation information elements.

FIG. **3** is a diagram of the main components of a wireless situation information system for topographically irregular environments, including those in cities.

FIG. **4** is a diagram of a situation information device which includes multiple peripheral devices such as an enclosed telephone handset with digital camera and bar-code label reading device, exemplary display showing an urban plan, and other graphical situation information elements.

FIG. **5** is a diagram of the main components of a situation information system for comparatively regional, open environments.

FIG. **6** is a diagram of a situation information device with graphical display showing a exemplary metropolitan area plan and other graphical situation information elements.

FIG. **7** is a perspective drawing showing the rear view of a situation information system connected to a fixed-services bracket for use in a vehicle or building.

FIG. **8** is a diagram of the major connection components of a situation information device and fixed-services bracket in an exemplary vehicle installation.

FIG. **9** is a diagram of an exemplary embodiment of a telecommunications handset, including photonic link to its separate host device, which includes additional peripheral devices.

FIG. **10** is a perspective drawing of the use of a situation information device with separate, photonically linked handset for telecommunications in which the user simultaneously refers to information displayed by the situation information device.

FIG. **11** is a diagram of the display portion of an exemplary situation information device showing the look-ahead function displaying map elements of a given local area.

FIG. **12** is a diagram of the mappable hypertext code sequence for displaying rapidly mappable and executably selectable information, individually called mappable hypertext items, to a mobile device for display.

FIG. **13** is a flow diagram of the main components of the service provider computer control program of the preferred embodiment of a situation information system.

FIG. **14** is a flow diagram of the main components of the user computer control program of the preferred embodiment of a situation information system.

FIG. **15** is a flow diagram of the main components of the visit list computer control program of the preferred embodiment of a situation information system.

FIG. **16** is a flow diagram of the main components of the keyword-search computer control program associated with the visit list control program of the preferred embodiment of a situation information system.

Description of situation information system basic alternate embodiment in FIGS. **1** and **2**:

Referring now to FIG. **1** which shows an alternative embodiment of a situation information system used in a defined environment such as a shopping area in which can be seen rf antennas **14***a*, **14***b*, and **14***c*, the locations of which are known, and which generally transmit and receive information from mobile computers **18***a*, **18***b*, and **18***c*. Specifically in FIG. **1** antennas **14***a* through **14***c* are shown receiving information **16***a*, **16***b*, and **16***c* as well as **16***d*, **16***e*, and **16***f* from mobile computers **18***b* and **18***c*, respectively, to provide services from the service provider including finding the locations of the aforementioned mobile computers and receive information requests. In addition, antenna **14***b* is shown transmitting and receiving information **15***a* to and from mobile computer **18***a*. Antennas **14***a*, **14***b*, and **14***c* are connected to control system **36***a* by way of transceiver-A **32***a*, transceiver-B **32***b*, and transceiver-C **32***c*, respectively. Control system **36***a* is connected to data and memory components **38***a* and **39***a*, respectively, and to other systems including global communications network **31***a* by way of computer network **30***a*. In addition, control system **36***a* receives precise time signals from satellite **20***a* by way of satellite information transmission **22***a*, information reception **22***b*, satellite rf antenna **21***a*, and GPS receiver **34***a*; satellite rf antenna **21***a* is shown located outside the building structure **25** to receive satellite information.

The service provider includes transceivers **32***a*, **32***b*, and **32***c*, antennas **14***a*, **14***b*, and **14***c*, GPS receiver **34***a*, GPS antenna **21***a*, control system **36***a*, network **30***a*, data **38***a*, memory **39***a*, and communications network **31***a*. The radio locating instrument signaling function is shown operating on two devices, **18***b* and **18***c*. That of mobile device **18***b* is provided by satellite **20***a*, satellite information transmission **22***a*, satellite information reception **22***b*, satellite antenna **21***a*, GPS receiver **34***a*, severally either mobile computer **18***b* or **18***c*, information **16***a*, **16***b*, and **16***c* or information **16***d*, **16***e*, and **16***f*, respectively, antennas **14***a*, **14***b*, and **14***c*, transceivers **32***a*, **32***b*, and **32***c*, and control system **36***a*.

FIG. **2** shows a basic alternate embodiment of a situation information device **2***a* which is a handheld computing and wireless communications device with control programs specific to a situation information system such as that shown in FIG. **1**, device **2***a* includes a touch-screen graphical display unit **4***a*, controls **7***a*, **7***b*, **7***c*, and **7***d* provide user-modifiable control for device **2***a* power, display **4***a* contrast, brightness, and speaker **7***e* loudness, respectively, speaker **7***e*, IR transceiver **13***a* for communication with other devices, and rf antenna **14***d*. Aforementioned graphical display unit **4***a* shows information including retail-store floor-plan proximate information station **3***a*, floor-plan information feature exit symbol **3***b*, floor description information **3***c*, and escalator symbol **3***d*, visit list program control icon **5***a*, and service provider search hit icon **5***b*, device location and direction symbol **6***a* which symbol can be a mappable hypertext item that the user may executably select in order to receive additional information or execute computer code associated with it as described in FIG. **12** below, north direction symbol **6***b*, service provider menu **6***c*, proximate station banner **6***d*, proximate merchandise banner **6***e*, which may be made to appear animated, the latter three of which may also be mappable hypertext items, device control icon **8***a*, and display scroll icon **8***b*. Additionally, symbols of other devices, such as other device symbol **6***s* in FIG. **11**, which indicate their users' locations through the use of a graphical symbol may be shown in their appropriately mapped locations on display **4***a*.

Operation of the situation information system basic alternate embodiment shown in FIGS. **1** and **2**:

Referring to FIG. **1** in which is shown two modes of operation of subject invention, the first mode, location finding, occurs in which transceivers **32***a*, **32***b*, and **32***c* are time-calibrated and synchronized by means of precise timing signals introduced to control system **36***a*, such as from satellite **20***a* via information transmission **22***a*, information reception **22***b*, satellite rf antenna **21***a*, through building structure **25** to GPS receiver **34***a* and thence to control system **36***a*. One of transceivers **32***a*, **32***b*, or **32***c*, on an optionally rotating basis or other scheme, periodically transmits a gating pulse, via antennas **14***a*, **14***b*, and **14***c*, respectively, to a transponder (not shown) located in each of situation information devices **18***a*, **18***b*, and **18***c*, such as device **2***a* in FIG. **2**, each of which transponders subsequently respond to the received gating pulse by transmitting an rf signal such that the differences in arrival times of which the signal at each of the aforementioned antenna-and-transceiver pairs are used to compute the intersections of each envelope of distance of each of the transponder containing devices from each of the antennas and the location of each of the aforementioned devices thereby.

Accompanying each of the transponder signals is an identification code which uniquely identifies its device by means of which the location of each user is determined and identified by the situation information service provider. The

user's location coordinates are then transmitted to the user's device for incorporation into display-program variables (not shown) and presented appropriately on display **4***a* in FIG. **2**. Additionally, the service provider may wish to gather marketing and traffic data in order, for example, to determine the effect of certain merchandise or other displays on traffic patterns, speed, frequency of visitation, duration of viewing, etc.

The second mode of subject invention's operation, that of providing situation information services, occurs in which the location of the mobile situation information device **18***a*, being updated in service provider memory **39***a*, is correlated with proximate information to be transmitted, user-provided filters and options (shown in FIG. **14**, below), and requested information from, depending upon the requested information's nature and location, data **38***a*, network **30***a*, and communications network **31***a*. Certain information device users, such as that of device **18***b* used by a physically impaired user, may require alternatively conveyed information, such as that which is verbally or tactilely conveyed from an appropriately configured device.

The basic embodiment situation information device **2***a* shown in FIG. **2**, having been connected or logged on to the service provider's system in FIG. **1** and the device's position being known by the information system of FIG. **1**, i.e., residing in memory **39***a*, operates by receiving information via antenna **14***d*, conveying the information to the user via display **4***a* and speaker **7***e*, the characteristics of which information can be changed by the user via controls **7***a* through **7***d*. As the user's location, shown on the display by device location and direction symbol **6***a*, approaches within a selectable distance of proximate information station **3***a*, proximate station banner **6***d* appears on display **4***a*, followed by proximate merchandise banner **6***e* to call user's attention to, for example, a short-term offer of merchandise which, as mappable hypertext items, may be executably selected by user to provide additional information or execute as computer code as described in FIG. **12** below. User may orient himself or herself globally by north direction arrow **6***b*, within the building by floor information **3***c*, within the floor by exit symbol **3***b* near exit doors to street named on a map, and floor plan details such as escalator symbol **3***d*. Additionally, user may change or scroll the portion of floor plan in view on display **4***a* by pressing, or executably selecting, the appropriate arrow of display scroll icon **8***b* to move the view in that direction.

The user may optionally access other service provider functions by selecting from service provider menu **6***c*, other device functions, e.g., e-mail, by selecting device control icon **8***a*, conduct a search of current service-provider information and which results appear on display **4***a* by search hit icon **5***b* which is shown positioned adjacent to menu item "Contact us" which serves to implement retrieval of the desired information, or enter information through unattached peripheral devices (not shown) such as keyboards which may communicate with device **2***a* via IR transceiver **13***a*. User may optionally download other information from a prepared list of sources automatically while viewing the information currently shown on display **4***a* and view the other (see FIG. **13**), subsequently received information by executably selecting visit list control icon **5***a* causing the computer to proceed in processing or executing the pertinent information or code.

Description of situation information system alternate embodiment in FIGS. **3** and **4**:

Referring now to FIG. **3** which shows a situation information system used in environments of irregular natural or man-made topographic relief such as canyons and cities, respectively, in which can be seen rf antennas **14***e* and **14***f* of known location which generally transmit and receive information to and from pedestrian mobile situation devices **18***d* and **18***e* and vehicle mobile devices **19***a* and **19***b*, the distinction in mobile devices being that the latter is carried in a vehicle as shown in FIGS. **7** and **8**. In the figure, antennas **14***e* and **14***f* are shown receiving information **16***g* and **16***h*, from vehicle mobile device **19***a*, and **16***i* and **16***j*, from pedestrian mobile device **18***e*, to provide services from the service provider including finding the locations of mobile devices, similar to device **2***b* in FIG. **4**, and receive information requests. In addition, antenna **14***e* is shown transmitting and receiving information **15***b* and **15***c* to and from pedestrian mobile device **18***d* and vehicle mobile device **19***b*, respectively. Antennas **14***e* and **14***f* are connected to control system **36***b* by way of transceiver-A **32***d* and transceiver-B **32***e*, respectively. Control system **36***b* is connected to data and memory components **38***b* and **39***b*, respectively, and to other systems including global communications network **31***b* by way of computer network **30***b*. In addition, because topographical features **23***a* and **23***b* interfere with ground-level reception of sufficiently diverse GPS signals for reliable position determination, the aforementioned mobile devices function as transponders, signals from which devices are gated by one of the available satellite rf signals. Thus, control system **36***b* selectively receives accurate time and transponder-pulse gating signals from either satellite **20***b* or **20***c* by way of satellite information transmission **22***c* or **22***d*, respectively, information reception **22***h*, satellite rf antenna **21***b*, and GPS receiver **34***b*. In addition, vehicle mobile devices **19***a* and **19***b* are shown receiving the aforementioned time and gating signals via information reception **22***e* and **22***f*, respectively. Pedestrian mobile device **18***e* also receives the same information signals via information reception **22***g* through the device's built-in antenna (not shown).

The service provider includes transceivers **32***d* and **32***e*, antennas **14***e* and 14f, GPS receiver **34***b*, GPS antenna **21***b*, control system **36***b*, network **30***b*, data **38***b*, memory **39***b*, and communications network **31***b*. The radio locating instrument signaling function is shown operating on two devices, **19***a* and **18***e*. That of vehicle mobile device **19***a* is provided by satellite **20***b* or **20***c*, satellite information transmission **22***c* or **22***d*, respectively, satellite information reception **22***e* and **22***h*, satellite antennas **21***b* and **21***c*, GPS receiver **34***b*, vehicle mobile computer **19***a*, antenna **14***g*, information **16***g* and **16***h*, information **16***i* and **16***j*, antennas **14***e* and **14***f*, transceivers **32***d* and **32***e*, and control system **36***b*. The radio locating instrument signaling function of pedestrian mobile device **18***e* is provided by satellite **20***b* or **20***c*, satellite information transmission **22***c* or **22***d*, respectively, satellite information reception **22***g* and **22***h*, satellite antenna **21***b* (pedestrian mobile device antennas are not shown), GPS receiver **34***b*, pedestrian mobile computer **18***e*, information **16***i* and **16***j*, antennas **14***e* and **14***f*, transceivers **32***d* and **32***e*, and control system **36***b*.

FIG. **4** shows alternate embodiment situation information device **2***b* which is a handheld computing and wireless communications device with control programs specific to a situation information system such as that shown in FIG. **2**. Device **2***b* includes a touch-screen graphical display unit **4***b*, device control **7***f*, speaker **7***g*, IR transceiver **13***b* for communication with other devices, and rf antenna **14***i*.

Graphical display unit **4***b* shows information including such as proximate information station retail store **3***e*, information features such as bank **3***f*, street name **3***g*, and side-

walk curb 3*h*, visit list program control icon 5*c* and service provider search hit icon 5*d*, device location and direction symbol 6*f*, north direction symbol 6*g*, service provider menu 6*h*, sub-menu 6*i*, which two menus are mappable hypertext items that the user may executably select in order to receive additional information or execute computer code associated with them as described in FIG. 12 below, and display scroll icon 8*c*. In the cut away portion of device 2*b* can be seen electronics enclosure 2*c* and telecommunications handset 9*a* which includes components such as extendable mouthpiece 9*b*, microphone 9*c* (shown in phantom), and mouthpiece hinge 9*d*, ear piece speaker 9*e*, digital copying camera 9*f*, camera lense assembly 9*g*, camera operation button 9*h*, and bar-code reader 9*i*. Handset 9*a* is secured by integral handset lip lid within the housing of device 2*b* by latch 11 which rotates around pivot pin 11*a* and handset 9*a* is urged from the housing of device 2*b* by the user-initiated action sequence of depressing release button 11*b* which retracts locking device 11*c* as it rotates around lock hinge 11*e* against the force of spring 11*g* allowing latch 11 to rotate relatively outwardly due to the urging of compressed spring 11*f* and stop against stop 11*h* after partially ejecting handset 9*a* from the housing. Handset 9*a* is electrically connected to device 2*b* by way of cord 13*c* which is extendably stored on spring-loaded (not shown) retracting reel 13*d*.

Operation of the situation information system alternate embodiment shown in FIGS. 3 and 4:

Referring to FIG. 3 which shows two modes of operation of subject invention, the first mode, location finding, occurs in which transceivers 32*d* and 32*e* are coordinated with local information devices and prepared to receive transponder signals by receipt of the pulse-gating timing signal introduced to control system 36*b* from appropriate satellite 20*b* or satellite 20*c* via information transmissions 22*c* or 22*d*, respectively, information reception 22*h*, satellite rf antenna 21*b* to GPS receiver 34*b*. Vehicle mobile situation information devices 19*a* and 19*b* and pedestrian mobile situation information device 18*e* receive pulse-gating signals from one of the satellites via information reception 22*e*, 22*f*, and 22*g*, respectively, and each of the devices subsequently responds by transmitting an rf signal such that the differences in arrival times between receipt of the satellite signal and the transponder signals at each of the antenna and transceiver pairs are used to chronometrically compute the intersections of each distance envelope pertaining to the separation of each of the transponder-containing mobile devices from each of the antennas and, hence, determining the location of each of the situation information devices. Accompanying each of the transponder signals is an identification code which uniquely identifies each device by means of which the location of each user is known and identified by the situation information system. The user location coordinates are then transmitted to the user's device for incorporation into display-program variables (not shown) and presented appropriately on the display as location and direction symbol 6*f*. Additionally, the service provider may wish to gather marketing and traffic data in order, for example, to determine the effect of certain merchandise displays, signs, or media presentations on traffic patterns, speed, frequency of visitation, duration of viewing, etc.

The second mode of subject invention's operation, that of providing situation information services, occurs in which information transmission pertaining to the location of pedestrian mobile situation information device 18*d* and vehicle mobile situation information device 19*b*, being updated in service provider memory 39*b*, are correlated with proximate information to be transmitted, user-provided filters and options (shown in FIG. 14, below), and response to user-requested information from, depending upon the requested information's nature and location, data 38*b*, network 30*b*, or communications network 31*b*, or combination thereof. Certain information service users, such as device 18*e* being used by a physically impaired user, may require alternatively conveyed information, such as verbally conveyed information or, for example, from a device having a tactile surface consisting of a dynamic bed of changeable, flat-top pins for conveying information tactilely (not shown).

The basic situation information device 2*b* shown in FIG. 4, having been connected or logged on to the system and its position being known by the situation information system of FIG. 3, operates by receiving information via antenna 14*i*, conveying the information to the user via display 4*b* and speaker 7*g*, the characteristics of which can be changed by the user via controls including control 7*f*. As the device user's mapped location, shown on the display by device location and direction symbol 6*f*, approaches within a selectable distance of environment proximate information features, such as retail store site 3*e*, an advertising message such as service provider menu 6*h*, or an optional advertising message (not shown), would appear on the display awaiting the user's request for information or services. This operational description assumes the user has initiated a service-provided keyword search for information about "Hiking Gear". Should the user also wish to know, for example, what the merchant's current, short-term offers are, the user would select the menu portion entitled "1 hr. Specials" which causes sub-menu 6*i* to appear on the display showing categories of merchandise included in the aforementioned offers. Search hit icon 5*d*, with "Hiking Gear" message which is similar in use to that of search hit icon 5*b* above, is shown overlapping the portion of the submenu entitled "Children's" which indicates that a 1 hr. Special in the Children's Dept. offering Hiking Gear is currently in effect. The system user, indicated by device location and direction symbol 6*f* and which may be a mappable hypertext item as described below in FIG. 12, may orient himself or herself globally by north direction arrow 6*g*, by building occupant information such as store 3*e* and bank 3*f*, by street name 3*g* on map, and sidewalk curb 3*h*. User may elect to receive information from other service providers by operating a visit list program (shown in FIG. 13), in which case, executably selecting visit list control icon 5*c* would cause the first site's information to be presented on the display. Additionally, the user may change or scroll the portion of map in view on the display by pressing the appropriate arrow of display scroll icon 8*c* to move the view in the arrow's direction.

Referring still to FIG. 4, handset 9*a* is released from latch 11 by the depression of latch release button 11*b* which causes the latch to deploy handset 9*a* by urging integral lip 11*d* relatively outwardly as described above. Handset 9*a* may be used for multiple functions including voice communications by initiating telecommunications operations through selecting the appropriate display-based menu group (not shown), speaking through speaker 9*c* in mouth piece 9*b*, which, urged by spring (not shown), deploys rotationally about pivot 9*d* as handset is deployed from device housing as the user pulls relatively outwardly against retractile force of spring-loaded (not shown) reel 13*d* acting on cord 13*c*, listening through speaker 9*e*, through transceiver means (not shown) located substantially within electronics enclosure 2*c*, and radiatively to service provider, including other telecommunications services, through antenna 14*i*. Alternatively, after executably selecting appropriate display-based settings (not shown) digital copying camera 9*f* peripheral device,

located within handset **9***a*, may be used in place of a document scanner for digitally copying documents or recording scenes by framing subject matter appropriately in view of display **4***b* and pressing button **9***h* to record the viewed scene through lense **9***g*.

Because lense diameters of digital camera units are of the order of a quarter of an inch, hyperfocal distances are significant and, therefore, a general-purpose camera can have a fixed-position lense. A subset of recorded, i.e., captured image, subject's graphical information (not shown) can be displayed on the display in order to reduce bandwidth requirements and, therefore, time required to begin recording a subject. Handset **9***a*, when appropriately deployed and configured by display-based settings (not shown) includes UPC bar-code reader **9***i* peripheral device for reading and deciphering bar-code labels on street signs to determine map coordinates and names of intersecting streets should situation information service be unavailable, for example, or information about products, and storage container contents. Information derived from copied documents, digitized scenes, or deciphered bar codes, can be communicated to other users on other systems, networks, or communication modes through the service provider. Handset **9***a* may alternately be constructed to communicate wirelessly with device **2***b* as with device **2***e* shown in FIG. **10**.

bar code reader

Description of situation information system preferred embodiment in FIGS. **5** and **6**:

Referring now to FIG. **5** which shows a situation information system for use in comparatively open environments which includes transceiver **32***f* which generally transmits and receives information to and from mobile situation devices located in vehicles **19***c* and **19***d* by way of rf antenna **14***h*. Transceiver **32***f*, by way of its antenna, is shown transmitting and receiving information **15***d* and **15***e* to and from the mobile devices (not shown) represented as being located within vehicles **19***c* and **19***d*, respectively, by means of antennas **14***i* and **14***j*, respectively, in the manner shown in FIGS. **7** and **8**, below. Transceiver **32***f* connects to control and data system **36***c*, which, in turn, connects to differential computer **38***c* and memory **39***c* and to other systems including global communications network **31***c* by way of computer network **30***c*. Control and data system **36***c* receives GPS signals from satellites **20***d*, **20***e*, and **20***f* by way of satellite information transmissions **22***i*, **22***j*, and **22***k*, respectively, information reception **22***p*, GPS antenna **21***e*, and GPS receiver **34***c*. The mobile devices located in vehicles receive GPS signals from the satellites via satellite information transmissions **22***i*, **22***j*, and **22***k* and information reception **22***m* and **22***n*, respectively, and GPS receivers **21***f* and **21***g*, respectively, as further shown in FIG. **8**.

The service provider includes transceiver **32***f*, antenna **14***h*, GPS receiver **34***c*, GPS antenna **21***e*, control system **36***c*, network **30***c*, differential computer **38***c*, memory **39***c*, and communications network **31***c*. The radio locating instrument signaling function for vehicle mobile device **19***c* is provided by satellites **20***d*, **20***e*, and **20***f*, satellite information transmission **22***i*, **22***j*, and **22***k*, respectively, satellite information reception **22***m* and **22***p*, satellite antennas **21***e* and **21***f*, GPS receiver **34***c*, antennas **14***i* and **14***h*, information **15***d*, transceiver **32***f*, and control system **36***c*. The radio locating instrument signaling function for vehicle mobile device **19***d* is provided by satellites **20***d*, **20***e*, and **20***f*, satellite information transmission **22***i*, **22***j*, and **22***k*, respectively, satellite information reception **22***n* and **22***p*, satellite antennas **21***e* and **21***g*, GPS receiver **34***c*, antennas **14***j* and **14***h*, information **15***e*, transceiver **32***f*, and control system **36***c*.

FIG. **6** shows a preferred embodiment situation information device **2***c* which is a handheld computing and wireless communications appliance with control programs (not shown) of the situation information system such as that shown in FIG. **5**. Device **2***c* includes a touch-screen graphical display unit **4***c*, device controls **7***h*, **7***i*, **7***j*, and **7***k*, speaker **7***m*, IR transceiver **13***e* for data communication with other devices, and rf antenna **14***k*. The graphical display unit, display **4***c*, shows information including regional highways **3***i*, highway information **3***j*, visit list program control icon **5***e* and service provider search hit icon **5***f*, device location and direction symbol **6***j*, north direction symbol **6***k*, traffic congestion indication **6***m*, traffic congestion legend **6***n*, device control icon **8***d*, display scroll icon **8***e*, look-ahead icon **8***f*, proximate information menu **6***p*, and proximate information submenu **6***q*, which latter two menus and device location and direction symbol **6***j* may be mappable hypertext items as described below in FIG. **12**.

Operation of the situation information system preferred embodiment shown in FIGS. **5** and **6**:

Referring to FIG. **5** in which vehicle-located mobile situation information devices **19***c* and **19***d* of subject invention can be seen providing situation information, in the form of mobility-related information about each of the devices as well as information and services requests, by way of antennas **14***i* and **14***j*, respectively, and information **15***d* and **15***e*, respectively to the situation information service provider by way of antenna **14***h*, and the devices themselves receiving situation information from the provider, in the form of processed traffic data, other proximate situation information, and other services. The approximate locations of the devices are derived from timing signals received from the GPS satellite constellation, i.e., those satellites available for providing positioning information, of GPS satellites **20***d*, **20***e*, and **20***f* by way of satellite transmitted information **22***i*, **22***j*, and **22***k*, respectively, to devices **19***c* and **19***d* by way of satellite received information **22***m* and **22***n*, respectively, and GPS antennas **21***f* and **21***g*, respectively. As the devices' users log on to the situation information service provider by broadcasting users' identification codes and, optionally, global coordinates, the service provider responds with each user's channel assignment, which channel may be a specific rf, a digital-code channel, or another communications channel selection scheme. Note that the service provider receives GPS information **22***p* from the GPS satellite constellation to GPS receiver **34***c* by way of GPS antenna **21***e*, and the information is processed by differential computer **38***c* to derive the corrections necessary to produce mappably accurate global position or coordinates of the mobile device's GPS antenna and those of other users substantially throughout the service provider's service area. At an early point in a communication session the service provider may also respond to each user with GPS corrections specific to each satellite currently in use by the situation information system and the users such that the devices compute differentially corrected global positions.

Alternatively, given sufficient information communication and processing bandwidth, the service provider may compute each user's corrected position coordinates and transmit each user's coordinates back to the appropriate user. Users' positions may be broadcast to all pertinent users such as shown in FIG. **11** and its associated description. The service provider receives and transmits the information with transceiver **32***f* by way of the antenna **14***h*, computes corrected global position, correlates actual position and velocity data collected individually from users' periodic transmissions in control and data system **36***c*, interpolating as appro-

priate to provide graphically integral information from sparse data sets, and transmits the corrected position data individually and correlated position and velocity data to all users, providing the users with coherent, timely information. The service provider updates information about the location of the devices in service provider memory **39***c*, which is then correlated with proximate information to be transmitted and modified by user-provided filters and options shown in FIG. **14**, below. Additionally, the service provider responds to the users' requests for services including proximate situation information, communications services to other of the aforementioned devices, services to other networks **30***c*, and services to communications network **31***c* for remote access to other systems, for example.

Information device **2***c* in FIG. **6**, being located within a vehicle with connection to external antennas, as shown in FIGS. **7** and **8**, is assumed to having been connected to or logged on to the service provider's system and the device's position being known by the situation information system of FIG. **5**, i.e., residing in memory **39***c*, operates by receiving information by way of antenna **14***k*, conveying the information to the user with display **4***c* and speaker **7***m*, the characteristics of which can be changed by the user through device controls **7***h* through **7***k*. As the user's location, shown on the display by device location and direction symbol **6***j* as being in the eastbound lane of K. Goedel Blvd., approaches within a selectable distance of the proximate interchange, proximate information menu **6***p* appears on the display or alternatively may be executably selected to appear by the user as shown in FIGS. **11** and **12**, including proximate submenu **6***q* to provide user with information pertinent to the attractions located near the relatively approaching highway interchange. Traffic congestion indication **6***m*, is interpreted by means of traffic congestion legend **6***n* and which may be interpolated from a sparse data set, may induce user to alter travel direction or telephone his or her delay by way of telephone handset **9***j*. User may also orient himself or herself globally by north direction arrow **6***k*, within the interchange area by referring to map details such as highway outlines **3***i* and highway name **3***j*.

Additionally, user may change or scroll the portion of area plan in view on the display by executably selecting the appropriate arrow of display scroll icon **8***e* to move the viewing window in that direction. User may optionally access other device functions, e.g., e-mail, by executably selecting device control icon **8***d*, conduct a search of current service provider information, in this example "EnergySta (tions)" and which results appear on the display by service provider search hit icon **5***f* which is shown positioned adjacent to menu item "AutoServices" which serves to implement retrieval of the desired information, or enter information through unattached peripheral devices (not shown) such as keyboards which may communicate with the device via IR transceiver **13***e*. User may optionally download other information from a prepared list of sources (see FIG. **13**) while viewing the information currently shown on the display and view the aforementioned other information by pressing visit list control icon **5***e*. Look ahead icon **8***f* selectably provides information for areas beyond user's current area as described in FIGS. **11** and **12** and below.

Description and operation of situation information system preferred embodiment in FIGS. **7** and **8**:

FIG. **7** shows a situation information device **2***d* inserted in insertion direction **41***a* into interface bracket **40**, which includes tilt-adjustment hinge **40***a* and, at the rear of the bracket are external power supply cable **42***a*, local network circuit **42***b*, external input cable **42***c*, external GPS antenna circuit **42***d*, and external rf antenna circuit **42***e*. For advantageous viewing bracket **40** may be optionally rotated on the axes represented by tilt arrow **41***b* and swivel arrow **41***c*.

Referring now to FIG. **8** which shows a diagram of device **2***d* in the process of being inserted into and connected to bracket **40**, shown by insertion arrow **41***d*, for the purpose of connecting to off-device resources including power supply cable **42***a*, network circuit **42***b*, input cable **42***c*, GPS antenna circuit **42***d*, and rf antenna circuit **42***e* by way of bracket connector pins **44***a* through **44***e*, respectively, substantially contained in interface bracket **40**. Upon insertion of the device into the bracket, bracket pins **44***a* through **44***e* respectively connect to corresponding pin receptacles **45***a* through **45***e*, which are connected to power supply switch circuit **43***a*, network interface **43***b*, input interface **43***c*, GPS antenna switch circuit **43***d*, rf antenna switch circuit **43***e*, respectively, integral with the device. The GPS antenna circuit receives external GPS information **22***r* by way of GPS antenna **21***h* which directs the information signal through structure **25***a*; similarly, the rf antenna circuit receives external rf information **15***k* by way of rf antenna **14***j* which, by way of its associated circuitry, directs the information signal through interposing structure **25***a*.

The aforementioned circuits and interfaces include electronics components and configurations appropriate to the impedance balancing, powering, and information exchange between device **2***d* and the external systems or off-device resources, including interconnection when one or more of the device circuits and off-device resources are energized and operating, commonly referred to as hot plugging. Structure **25***a* includes building and vehicle structures. Network circuit **42***b* includes, for example, the Secure Personal Applications Network, U.S. patent application Ser. No. 08/613,725 Hollenberg. Device **2***d* may be removed from the bracket for hand-held use, for example, pedestrian use, by pulling the device in a direction relatively outwardly, in the reverse direction to that indicated by arrow **41***d*, and device **2***d* modifies its configuration to use internal or device resources only. The performance of the situation information device is increased and extended by connecting it to off-device resources or external systems. For example, device **2***d* may be inserted into bracket **40** mounted in a vehicle for greater operative mobility and used for networking with vehicular systems. Alternatively, bracket **40** may be mounted in a retail store location to which device **2***d* may be attached for composing e-mail using a keyboard supplied for customer use by the store. Yet other alternatives include a keyboard which may be stored within the device that slides out for use (not shown) or a separate keyboard that communicates by a photonic, including IR, link.

Description and operation of situation information system alternative embodiment in FIGS. **9** and **10**:

FIG. **9** shows wireless telephone handset **9***k* which includes peripheral devices including digital copying camera **9***m*, camera lense **9***n*, camera record button **9***p*, digital/analog conversion and memory circuitry **9***q*, bar-code reader **9***r*, handset speaker **9***s*, energy storage **9***t* and **9***u*, deployable mouthpiece **9***v*, handset microphone **9***w*, mouthpiece hinge **9***x*, mouthpiece deployed position **9***y*, and IR transceiver **13***f*.

FIG. **10** shows handset **9***k* in use as a telephone handset by user **19***f* in which digitized voice data is communicated to and from situation information device **2***e*, which includes handset storage space **2***f*, by bidirectional information communication **13***g*, which is received by device **2***e* through an IR transceiver (not shown) similar to that of IR transceiver **13***c* in FIG. **6**. Device **2***e* includes rf transceiver (not shown)

which transmits information **15***m* by way of radiative antenna **14***k* which is appropriately positioned away from the user's head area in order to reduce the rf radiation dose absorbed in the user's vital organs, particularly the brain. This reduction of rf radiation occurs according to the inverse-square law in which the radiation at a given distance from the original distance varies inversely proportionally to the square of the factor of change in distance. Thus, by doubling the separating distance, radiation received decreases to one-fourth the original; by ten times the separation, the radiation diminishes to one-hundredth of the original. Additionally, certain CMOS microchips, such as those potentially used for gathering light in digital cameras, are susceptible to EMWR interference.

By way of explanation of FIG. **10**, as the user deploys the handset for use from storage space **2***f* in the device, handset mouthpiece **9***v* deploys by rotating about hinge **9***x* of FIG. **9** through the urging of a spring (not shown), and the device provides the telephony function when the user selects the appropriate menu function set (not shown) on the display of the device. The transceiver and the radiative antenna are naturally positioned away from the user who may view data displayed (not shown) by the device during a telephony function. Alternatively, user may generate situation information by copying documents or recording scenes using the copying camera or bar-code reader peripheral devices to generate information reader for communication to the device via the IR link.

Description and operation of situation information system device display and mappable hypertext code sequence in FIGS. **11** and **12**:

FIG. **11** shows a portion of device **2***g* with display **4***d* which displays exemplary map data of locations in advance of the mobile user's current location and is called a look ahead session. The graphically displayed map data, which may consist of mappable hypertext code sequences such as that shown in FIG. **12**, includes element road **3***k*, elements Deneba **3***m* and Pietown **3***n* which represent towns, element mountain **3***p*, and element Airport **3***q*. Shown also are visit list control icon **5***g*, device location and direction symbol **6***r*, other device symbol **6***s* which is a symbol representing the location of another similar device whose user has selected that the symbol be displayed along with other device information **6***t* which shows that other user's name, vehicle description as a green Toyota, and an executable option to contact the other user by e-mail or through other optional communications methods. Continuing with FIG. **11** and the contents of display **4***d* are look ahead information menu **6***u*, look ahead list **6***v*, mileage tabulation **6***w*, estimated transit time **6***x*, north direction symbol **6***y*, device control icon **8***g*, display scroll icon **8***h*, and look ahead icon **8***i*. FIG. **12** shows mappable hypertext code **29** consisting of element item reference **29***a*, identifier **29***b*, location **29***c*, and data type **29***d*.

A computer memory organized to include mappable hypertext code sequence **29** in FIG. **12** provides for rapid display of mappable information items, including map features, information sources, names, menus, and lists, certain of which may be executably selected by a user in order to display additional information related to any of such items, called a hypertext element, by receiving new information transmitted from the service provider. Additionally, code **29** provides for graphically displaying on the user's display symbols and text appropriately relating to the items and in a manner which shows each item in a measurably appropriate relation to other such items of geographical features shown on the display in an information sequence of data elements. Element item reference **29***a* is a code which determines the ordering of a particular element in a display of a table of similar such items or within a database of such information.

For example, should code **29** refer to a merchant desiring out-of-order placement of the merchant's information in an ordered display of similar information, item reference **29***a* would be appropriately changed to automatically provide the out-of-order placement on a user's display of such information. Element identifier **29***b* provides the mapped item's name and, if applicable, the location or address, which may be a URL, of its additional information. Element location **29***c* provides the item's geographical location, in longitude and latitude or in reference to a given feature which the element location provides. Element data type **29***d* provides information as to whether the item's symbol, icon, or name is capable of being included with other items in a executably selectable menu which appears to pop up, that is, to quickly graphically appear adjacent to the icon or text item which was executably selected by the user, on the user's computer display, whether it is to be included in the map displayed on user's computer, and, if displayed, whether the item's symbol, which may be a standard display symbol which is resident in memory, including storage, on user's device, or the item name can be subsequently selected by a user to automatically provide additional information about the item, such as by enlarging the detail, called zooming in, or, for example, as hypertext, in which the item name or symbol can be selected or clicked on by a user to provide additional information. Data type **29***d* also includes executable code for animated icons or avatars (graphic elements which represent their users in such a display). Concise code such as mappable code **29** is particularly suited to low bandwidth information communication systems such as those which might be found in large areas.

After connection with the local information service provider, the user's location and look ahead request, initiated by selecting look ahead icon **8***f* in FIG. **6**, are communicated to the service provider which responds by sending the appropriate information. Device **2***g* receives mappable hypertext code for each item to be represented on the display, such as items **3***m*, **3***n*, **3***p*, **3***q*, and main roads. Items having standard display symbols resident in the device's memory, including storage, are called by the display program and displayed to expedite the display process by obviating transmission of that data. A linear element such as a road may be transmitted as a bit map or as multiple mappable hypertext codes to usefully display its changes in direction or as a single code with multiple location elements to indicate the start and stop location of each segment and features such as curves, intersections, etc. All the aforementioned items are displayed according to their geographic locations in the scale of the area to be viewed on the display, which area to be viewed is selectable and may be zoomed in or out, for example, along with user's location symbol **6***r*.

Other user symbol **6***s* provides a method to communicate with other device users, and use of such a symbol is optional to the user owning the symbol, as is the amount of information provided with the symbol which is executably selectable, as shown by other device information table **6***t*. Information which may be executably selected by user in order to receive additional information is arranged as executably selectable menus or hypertext items under look ahead icon **8***i*, including look ahead menu **6***u* and look ahead list **6***v*. Separations between displayed features such as user's location **6***r*, elements Pietown **3***n* and Deneba **3***m*, which are towns connected by exemplary highway **22**, as

well as to other listed towns, are calculated using distances derived from latitude and longitude, which have been appropriately converted to distance relationships, i.e., correcting local longitude for the local latitude prior to determining the map distance, and provided to the user as mileage tabulation **6***w* and estimated transit time **6***x* to other exemplary cities. Portions of the map lying outside the displayed area may be scrolled into view using scroll icon **8***h*.

Description and operation of situation information system service provider computer control program and user computer control program in FIGS. **13** and **14**:

FIG. **13** shows a flowchart, with element numbers within brackets, of SERVICE PROVIDER COMPUTER CONTROL PROGRAM **<90>**, generally consisting of computer controlling instructions and evaluations, by which subject invention, particularly, for example, control and data system **36***c*, processes users' communicated data and requests for information and services. After situation information service provider system loads the program at instruction ENTER **<91>**, the program collects stored operating parameters and data at INITIALIZE **<92>** and is then operationally able to provide sessions of user services. A typical user logs on at CONNECT USER **<93>** and the system determines user's validity by comparing user identification (ID) and password with memory-stored copies, assigns user a communications channel or channels through which further interactions are conducted, and receives user device location data at RECEIVE USER DATA & REQUEST FOR SERVICES **<94>**. The user data is processed to determine actual user device location and, optionally from receipt of subsequent location updates, velocity at PROCESS USER SITUATION DATA **<95>**. User location data is correlated with data from other users to provide near real time, vehicular traffic-pattern situation information for transmission to other users' devices for graphical display or, in the case of pedestrian traffic, for analysis in marketing studies or other use studies.

At UPDATE USER SITUATION INFORMATION **<96>** user's device location is transmitted to user's device for display accompanied with, for example and if appropriate to user's situation, graphical vehicular traffic pattern information. User information filters, which selectably limit and define the types of information the user suitably requires, and options include, prearranged communications services required by user on a regular basis, such as remote access to other computer networks, news services, including market data, etc., are received by the service provider which then updates them appropriately in UPDATE OPTIONS/FILTERS RECEIVED FROM USER **<97>**. Based upon user filters, options and location, the service provider selects appropriate information from the system database (DB) specific to user situation in SELECT DB INFORMATION FOR USER'S SITUATION **<98>**, and this information is transmitted to the user in PROVIDE SITUATION INFORMATION & SERVICES **<99>**. If the service provider receives new data or a services request from the user, that is, if evaluation RECEIVE NEW DATA OR SERVICES REQUEST? **<100>** evaluates to YES, the processing of program **<90>** loops back to instruction PROCESS USER SITUATION DATA **<95>**. However, should the user not send new data or request services such that evaluation RECEIVE NEW DATA OR SERVICES REQUEST? **<100>** evaluates to NO, the service session ends at RETURN **<101>**.

FIG. **14** shows a flowchart, with element numbers within brackets, of USER'S COMPUTER CONTROL PROGRAM **<120>**, generally consisting of instructions and evaluations, by which subject invention, particularly, for example, situation information device **2***c*, requests information and services and subsequently processes the information communicated from the service provider. After situation information device **2***c* loads the program at instruction ENTER **<121>**, the program causes the device to collect stored operating parameters and data from memory at INITIALIZE **<122>** and is then operationally able to begin a session. As user selects service provider and logs on at LOG ON TO SERVICE PROVIDER **<123>**, the device transmits user's ID and password, switches to assigned communications channel or channels through which further interactions are conducted. At DISPLAY EST. LOCATION **<124>**, user's position as of the last operation of user's device will show on user's display. At evaluation EST. MAP LOCATION ADEQUATE? **<125>**, user checks the display and, should the displayed position appear obviously incorrect, user may select NO and, at the prompt ENTER EST. LOCATION **<126>**, update the position manually. Should evaluation **<126>** evaluate to YES, processing continues to instruction SELECT FILTERS AND OPTIONS **<127>** in which user may selectably define the type of information required from the service provider and options required, such as remote access to a company computer network, e-mail, or display of location of selected alternate situation information devices such as a transponder carried by a child, advertising messages, etc. All such selections and information requests are sent, along with periodic location information reports or data, to the service provider at SEND REQUEST/DATA TO PROVIDER **<128>**.

Situation information from the service provider, including map-referenced information, advertisers' and merchants' messages, weather, news, including traffic congestion graphical data and accident reports, if appropriate to user's situation, filters, etc., are received at RECEIVE INFO. FROM PROVIDER **<129>**, at which point device **2***c* will update its data at UPDATE LOCAL SYSTEM **<130>**. Program **<120>**next proceeds through a series of evaluations of user's actions including whether user's location has changed at LOCATION CHANGED? **<131>**, which, if evaluating to YES, corresponds, for example, to the equivalent of the user having generated additional data and processing loops back to SELECT FILTERS AND OPTIONS **<127>**, and, if the filters and options remain unchanged, continues to send data in aforementioned instruction **<128>**. However, should user's location remain unchanged within the limits set by service provider according to computational bandwidth constraints, for example, or through the user's selection, and evaluation **<131>** evaluate to NO, program **<120>** next evaluates whether or not the user's device has recorded a new request for services, including information requests, at REQUEST SERVICES? **<132>** in which a YES evaluation causes processing to loop back to instruction **<127>**. Next, should no services or information be requested and evaluation **<132>** evaluate to NO, opportunity to change providers is offered with evaluation GO TO NEW PROVIDER? **<133>**, which, should user elect YES, causes the program to loop back to LOG ON TO SERVICE PROVIDER **<123>**. Should evaluation **<133>** evaluate to NO, user is queried as to whether or not the current session should be continued at evaluation CONTINUE SESSION? **<134>**, which, if evaluating to YES, causes processing to loop back to REQUEST SERVICES? **<132>**. Finally, should evaluation **<134>** evaluate to NO, program **<120>** may be terminated at RETURN **<135>**.

Description and operation of situation information system visit list computer control program in FIG. **15**:

FIG. **15** shows a flowchart, with element numerals within brackets, of VISIT LIST COMPUTER CONTROL PRO-

GRAM <200>which downloads sites from a list of information sites to devices such as device 2*c* during the time the user views, otherwise uses, or executes information obtained from sites downloaded earlier, including from other sources. The program generally consists of instructions and evaluations, by which subject invention, particularly, for example, situation information device 2*c* and visit list control icon 5*e* of FIG. 6, may be optionally employed by user to select among serially downloaded information providing sites. After the situation information device loads the program at instruction ENTER <201>, the program collects stored operating parameters and data at INITIALIZE <202> and is then operationally ready to begin the session. As user selects which of an optional plurality of visit lists to begin downloading, depending upon a commuting, vehicle-bound user's direction of travel or time of day or a stationary user's accustomed perusal of financial information, as examples, at instruction SELECT VISIT LIST <203>, a menu of available lists are caused to appear on device display 4*c* of FIG. 6 and a first visit list (not shown) is selected to take priority. The visit lists consist of a given number of information-providing sites on one or more networks of sites, to each of which is serially assigned a first number (not shown), which may be a pointer or reference to other appropriate locations in memory, for the purpose of numerically ordering the first list's sites' downloading, a download number, and a second number (not shown) for the purpose of ordering the first list's sites' execution, called an execute number, that is, making use of a given site's downloaded information by displaying, executing or processing the site's code, or otherwise making use of its information.

Further, download and execute numbers are each loaded into computer memory, such as a stack, an array, or a register (not shown), as examples. The first number is variously referred to herein as "download counter", "D/L CTR", or "D/L CT.", and the second number variously referred to herein as "Exe counter", "EXE CTR, or "EXE CT.", depending upon the drawing space appropriately available. After the visit list is selected, subject program <200> loads the first visit list's number of sites as first and second numbers in the download and execute counters, respectively, in LOAD D/L & EXE COUNTERS <204>. The visit list program, in order to accomplish its two primary tasks in apparent concomitance of the viewing or executing portion to the downloading portion, the latter taking precedence or priority because of the time-dependent nature of such downloading, requires the effect of simultaneous computer processing, such as multitasking or multiple program threads, or actual multiple processing by multiple processors. The program utilizes, for example, multitasking which is well understood in the computer industry and entails the switching from one task to the other, usually governed by a priority scheme, by a single processor by way of its control program or operating system. The multitasking begins with instruction BEGIN MULTITASKING <205> which allocates and arranges memory to receive each task's parameters as the computer switches from the site downloading task to the site execution task and back again, as necessary until tasks are completed. In operation, portions of the downloading site information may be stored in a buffer and subsequently moved to memory, including storage.

The site downloading task begins with the first site in the visit list, denoted by the first site's assigned serial downloading counter number occupying proximal position in memory, in D/LOAD SITE #(D/L CT.) <206>, where "(D/L CT.)" is the proximate number in the download counter and refers to the next visit list site address. Should a site not download in a timely fashion, program <200> provides a message to alert the user to the delay and to which the user may respond by selecting PROCEED 231. With downloading of site information completed, the download counter is decremented, i.e., reduced by one, in DECR. D/L COUNTER <208> and the download counter content is evaluated in D/L CTR>0? <210>. Should there be additional sites in the visit list to download, evaluation <210> evaluates to YES and processing loops back to download the next site in D/LOAD SITE #(D/L CT.) <206>. If any site cannot be reached or its downloading halts, D/L MESSAGE 212 provides that site's name. Should downloading be successful for all sites of the list which are capable of being located and downloaded, evaluation <210> evaluates to NO and a message is presented to the user that list downloading is completed in D/L MESSAGE <212> and processing proceeds to terminate multitasking at END MULTITASKING <220>.

The execution task begins at EXEC. SITE #(EXE CT.) <207> in which the site corresponding to the proximate site address in the execute counter and, initially, may be the site currently being downloaded, in which case the downloading task, specifically, the rate of the downloading, will take precedence over the execution task. After a given site is executed by, for example, being displayed on the device's display, the execute counter is decremented in DECR. EXE COUNTER <209> and processing proceeds to determine whether or not site downloading is advancing ahead of site execution by comparing the counters in evaluation D/L CTR<EXE CTR? <211>. Should the download counter equal the execute counter, that is, the same site being downloaded is being executed, evaluation <211> evaluates to NO and a "wait" message is presented to user, by way of the display or other means, in WAIT ICON <213> and processing returns to evaluation <211>. Should downloading be advanced in relation to execution and evaluation <211> evaluates to YES, processing proceeds to determine whether or not sites remain to be executed in EXE CTR>0? <215>, which causes, should there be more sites to execute and evaluation <215> evaluates to YES, processing to loop back to execute the next site in EXEC. SITE #(EXE CT.) <207>. If, to the contrary, evaluation <215> evaluates to NO, processing proceeds to query the user as to whether or not to repeat the current visit list execution in evaluation REPEAT EXE? <217>. Should execution repetition be selected and evaluation <217> evaluate to YES, the execution counter is reloaded at LOAD EXE CTR <219> and processing loops back to the beginning of the execution task at instruction <207>. If evaluation <217> evaluates to NO, multitasking terminates at END MULTITASKING <220>, similar in manner to the downloading task.

Processing continues at evaluation REPEAT D/L LIST <221> which repeats the downloading and execution of the same list sites in the event the user requires more current information from the aforementioned sites, which, if selected, causes processing to loop back to instruction LOAD D/L & EXE COUNTERS <204>. Should this evaluation evaluate to NO, the evaluation ADD NEW SITE? <222> is processed next and, evaluating to YES, processing continues to ADD NEW SITE ADDRESS <223>, in which one or more new site addresses are added, and thence to increment the download counter and the execute counter at INCR. D/L & EXE COUNTERS <224> appropriately before looping back to download and execute the added sites. Should evaluation <222> evaluate to NO, processing continues to evaluate whether or not the user wished to change to a new visit list at GO TO NEW LIST? <225> which, if evaluating to YES, processing loops back to select

a new visit list at SELECT VISIT LIST <203>. Should evaluation <225>evaluate to NO, sites located by keyword search program <300> in FIG. 14 and added as "temporary sites" to the visit list program <200> are deleted in DELETE TEMP. SITES <226> and program ends at RETURN <227>.

Additional instructions which operate globally on program <200> include PROCEED <231> and GO TO NEW LIST <232> which serve to interrupt the program at selectable locations in the course of the program's operation in order to provide for efficacious utility and, for purposes of simplifying their description, are shown in currently referred to FIG. 13 as not directly connected to the program. Interrupt instruction PROCEED <231> is optionally implemented by user actuation of icon 5*e*, and similarly to alternate embodiment icons 5*a* and 5*c* in FIG. 2 and FIG. 4, respectively, to cause program <200> to halt the processing of currently executing code and begin processing code referred to by the next number in the execution counter. For example, while viewing currently executing code from any given site, the code of a serially following site on the visit list is executed after PROCEED <231> is actuated and the executing code is appropriately halted. Instruction PROCEED <231> may optionally be used, as described above, for terminating the downloading of a slow-to-download site in favor of the downloading of a serially following site may proceed. The second of these global instructions, GO TO NEW LIST <232>, is actuated by user by way of a similar operation on an icon or menu item (neither of which is shown) in order to download or execute code of one or more sites on a list other than the current list.

Description and operation of situation information system keyword search computer control program in FIG. 16:

FIG. 16 shows a flowchart, with element numerals within brackets, of Site Keyword-term Search Computer Control Program <300> which searches information sites downloaded to devices including device 2*c* during the course of situation information system use including visit list program <200> in FIG. 13 and, for keyword terms found, adds the site, as a URL or address, associated with the keyword term, if available, to the visit list as a temporary site. Program <300> generally consists of instructions and evaluations, by which subject invention, particularly, for example, device 2*c* and visit list control icon 5*e* of FIG. 6, may be optionally employed by a user to select among such subsequently serially downloaded information providing sites. After device 2*c* loads the program at ENTER <301>, the program collects stored operating parameters and data, including data from a user-prepared list of keyword terms, at INITIALIZE <302> with which to subsequently perform a search for the keyword terms on each of the sites downloading or downloaded. LOAD SITE COUNTER <303> loads the site references, each of which may be, for example, a pointer to a memory location containing the URL or other appropriate connection path to the information source or site, from the visit list program's download counter into computer memory, such as a stack, an array, or a register (not shown), for example, and referred to herein as the site counter, and functions to maintain a record of which site is being searched.

Before proceeding, program <300> determines if at least one site has been fully downloaded by visit list program <200> and available for searching by evaluating whether or not the original download count in program <200> is greater than the current download count in program <200> in ORIG.+INCR. D/L CT.>CURR. D/L CT.? <304>. Should this evaluation evaluate to NO, processing proceeds to WAIT <305>, where it remains for a selectable period of time before looping back to evaluation <304> for re-evaluation. Should evaluation <304> evaluate to YES processing proceeds in a manner similar to instruction <303> above in which LOAD SEARCH COUNTER <306> loads keyword references into computer memory, which may be register pointers to keywords in memory, to maintain a record showing which keywords are being searched. The first search site and search keyword are selected and searched in SEARCH SITE #(SITE CT.) FOR TERM #(SEARCH CT.) <307>, where SITE CT. is the current count in the site counter and SEARCH CT. is the current count in the search counter, after which search aforementioned counter <306> is decremented in DECR. SEARCH COUNTER <308> to prepare for selection of the next search term or keyword. Should the currently searched-for term not be found, that is, TERM FOUND? <309> evaluates to NO, processing proceeds to check that at least one search term remains for searching in SEARCH COUNT>0? <312>. If the searched-for term is found in information contained in the current site, evaluation TERM FOUND? <309> evaluates to YES and determination is made in SITE ADDRESS? <310> whether or not an associated site address for the currently searched-for term can be found, which if not, evaluation <310> evaluates to NO and processing continues in SEARCH COUNT>0? <312>. Otherwise, with the associated address being found and this evaluation evaluating as YES, the site address associated with the searched-for term is added to visit list program <200> of FIG. 15 in current program <300> instruction ADD SITE TO VISIT LIST (AS TEMPORARY SITE) <311> before processing proceeds to SEARCH COUNT>0? <312>. Should terms remain to be searched in the current site information, SEARCH COUNT>0? <312> evaluates to YES and processing loops back to SEARCH SITE #(SITE CT.) FOR TERM #(SEARCH CT.) <307> to search for the next keyword search term.

Should SEARCH COUNT>0? <312> evaluate to NO, the site counter is decremented in DECR. SITE COUNTER <313> in preparation for searching the next site. In the event additional sites have been added to visit list program <200>, for example by ADD NEW SITE? <222> evaluating to YES, ADD NEW SITE ADDRESS <223> having functioned, and INCR. D/L & EXE COUNTERS <224> having incremented the download counter, all being in program <200> in FIG. 15, program <300> is similarly updated by adding duplicate increments to site counter <303> in ADD D/L INCR. TO SITE CT. <314>. The site counter is subsequently evaluated to determine whether sites remain to be searched in SITE COUNT>0? <315> following. Should evaluation <315> evaluate to YES, processing loops back to search all appropriately currently stored keyword terms in LOAD SEARCH COUNTER <306> after checking evaluation <304> to determine if at least one site has been downloaded, etc. Should evaluation <315> evaluate to NO, processing ends in RETURN <316>.

CONCLUSION, RAMIFICATIONS, AND SCOPE OF THE INVENTION

The situation information system has been described with reference to exemplary and preferred embodiments which the reader can see provide a high degree of accessible usefulness which will provide users with better, specifically timely and proximate, information. In addition, embodiments of this system will provide the richness of experience, by allowing users to participate in socially interactive settings, and capability, in conducting business and commerce in proximity to merchandise which is immediately

available, not possible with the Internet's remoteness and lack of physicality. It must be remembered that the descriptions herein, including the program flow charts, are static representations of dynamic systems capable of performing entirely new functions.

While the situation information system contains many specific elements, these elements should not be construed as limiting its scope. Many other variations are possible. For example, an embodiment of the situation information system could employ various means for generating and providing location information including a mix of satellite positioning system and transponding methods using many different gating-pulse signal sources. Also, an embodiment of the situation information device could include a withdrawably stored keyboard or hinged case element with integral keyboard or a video camera could take the place of the camera in the handset or such peripheral devices could be varied in their arrangement, as examples.

Accordingly, various other substitutions, modifications, changes, and omissions may be made in the design and arrangement of the elements without departing from the spirit of the invention as expressed in the appended claims.

I claim:

1. A scalable, openly accessible, dispatcher obviating, situation information system comprising:

a. mobile computers with radios severally operated by users substantially transmitting information including location data, receiving situation information of selectable execution, including audible, visual, and tactile execution, and continually receiving telephone numbers of diverse providers of services and merchandise while obviating the resulting interference imposed by the obligatory answering of a ringing telephone as automated updates occur, and conducting shopping functions in shopping areas including stores and malls,

b. radio locating means by which, from said location data including triangulation systems installed within and among buildings, the location of each of said mobile computers is determined and processed into location information including information pertaining to, and derivable from, the change in location of each of said mobile computers, and

c. one or more radio sources of said situation information, including said location information, proximate information and other information, for purposes including presenting entertainment, commercial offers, and advertising whereby users of said mobile computers with radios benefit from timely information pertaining to situations within their locus.

2. The system of claim **1** wherein said situation information, substantially organized according to said shopping areas and to the power level of radio transmission, and said outgoing information, including mappable hypertext items, pop-up messages, and icons, selectably relate to the area of each of said mobile computers whereby said users of computers are selectably interactively and reciprocatively provided with descriptive information about objects, people, and events within said area of any of said mobile computers.

3. The system of claim **2** wherein said user information and said other information includes communication with others of said users of said mobile computers and said sources and information pertaining to a search of said radio sources, including commercial offers of goods and services and user identification and credit-related information pertinent to commercial agreements whereby individuals among said users of said mobile computers can locate others of said mobile computer with radios and topical events, people, products, and services and arrange for payment and fulfillment of commerce efficiently.

4. The system of claim **3** wherein said user information and said situation information include entertainment information whereby users of said mobile computers can selectably assume fictional identities for purposes of entertainment and recreational games visually, audibly, or tactilely executed selectably within the area of any of said computers.

5. The system of claim **4** wherein said mobile computers with radios include bracket interfacing means to alternatively disconnectably connect to external systems including power supplies for charging batteries of said computers and circuits in buildings and conveyances in the locus of said shopping areas whereby said mobile computers can communicate with other systems including antennas, peripheral devices, and networks by means of wired connections.

6. The system of claim **5** wherein said location data is provided substantially by said mobile computers with radios to said source of said situation information for information about traffic patterns in said areas whereby traffic data are collected automatically by said radio locating means to aid organization of layout, merchandise, displays, and said user access to said area.

7. The system of claim **6** wherein said mobile computers with radios severally include a substantially separate peripheral device holder functioning as an exclusive satellite of, and communicating by means of photonic media solely with, said mobile computer and substantially containing a speaker, microphone, and one or more photon-related devices, including camera, bar-code reader or infrared devices, whereby information associated with use of said devices is processed by said mobile computer to enable said user to operate said peripherals without physical encumbrance due to the obstructive bulk of said computer, exposure to potentially harmful radiation affects associated with close operation of said radio of said computer, or being prevented from engaging in voice communications simultaneously with the viewing of said visual data appearing on the screen of said computer.

8. A method for conducting shopping functions in shopping areas including stores and malls wherein information is communicated wirelessly by providers of services and merchandise, including offers pertaining to the buying and selling of said services and merchandise, to potential customers severally using mobile computers with radios substantially continually receiving telephone numbers of said providers and obviating the resulting interference imposed by the obligatory answering of a ringing telephone as automated updates occur, comprising the steps of:

a. acting substantially simultaneously with receipt of a gating pulse from a transmitter, transmitting customer information, including identification and location information, severally by said mobile computers with radios, and receiving said identification and location information in said situation information system,

b. ascertaining subsequently whether said location information of a selected subset of said mobile computers with radios indicates said computers suitably proximate to said offers, or display thereof, presented by said providers, and

c. transmitting one or more said offers including by visual, aural, and other data types and other pertinent information, severally to said subset of said mobile computers with radios according to said customers' selections and contingently dependent on subsequent actions of said customers whereby said customers using

said computers with radios can shop more knowledgeably and efficiently.

9. The method of claim 8 wherein said actions of said customers include severally making responses to appropriate offers and subsequently communicating using said mobile computer with radios each of said responses, including bids, counter offers, and purchasing and credit information, to said situation information system associated with providers whereby mutually beneficial commerce is securely and easily conducted.

10. The method of claim 9 wherein said customer information includes data further processed by means selected from the group consisting of options and filters whereby said customers severally receive information, including goods and services information, appropriate to the requirements of said customers.

11. A method of communicatively executing, including making apparent to the aural and tactile senses of the user, one or more transmittable mappable hypertext items representing people, organisms, and objects, including buildings, roads, vehicles, and signs, on a computer in a manner scalably representing interrelationships of said objects, comprising the steps of:

a. searching each of one or more unique mappable information code sequences, each of which said code sequences serving to uniquely represent one of said items and copied from the memory of said computer or received from an alternate source, for a field containing geographical coordinates, said each of said code sequences includes an item reference field, a name field, a location field including said geographical coordinates, and a data field,

b. converting said coordinates to an appropriately proportionate representation on said computer, and

c. displaying selectably scalably said items on said computer whereby said user may quickly receive and display timely situation information mapped in the context of spatial information, including appropriate to a geographical or other area, in which said mappable hypertext items are quickly received, mapped, and optionally executably selected by said user to provide additional of said situation information or received, stored, and transmitted by a provider of said situation information.

12. The method in claim 11 wherein said interrelationships of said objects are distance quantities separating each of said objects and are represented by mappable hypertext items processed and selectably represented on said computer whereby time and distance to or between objects may be determined and delimited in order to cause additional information to be executed on said computer from sources, including memory and said service provider, and increase the efficiency of said user thereby.

13. The method in claim 12 wherein said mappable hypertext items include a user modifiable location symbol, including providing dynamic characteristics, whereby said user may choose representation by a unique icon on said computer which can be made to execute on others of said computers.

14. A method of receiving in a mobile computer substantially moving relative to locations of timely interest to the user of said computer, including one or more sources of transmitted digital information describing said locations including services and resources currently available at said locations from one or more selectable visit lists of said sources of said information capable of being organized according to said locations' proximity, timeliness, and other criteria into the memory of said computer, substantially continually receiving telephone numbers of providers of said services and resources and obviating the resulting interference imposed by the obligatory answering of a ringing telephone as automated updates occur, comprising the steps of:

a. executing information from a selectably precedent source of said digital information on said mobile computer, including being viewed on a display,

b. receiving substantially simultaneously information from subsequently selected of the remaining of said sources of said digital information from said organizable sources on said lists, and

c. storing said information from said sources in a retrievable manner in said mobile computer memory for execution selectably alternatively and timely, including preemptively or subsequently, to said information from any of said sources whereby time-critical, location-dependent information transmitted comparatively slowly from multiple sources of said digital information can be received by a traveler using said mobile computer in a timely way while information currently executing is utilized.

15. The method of claim 14 including a keyword search wherein proximate, timely, or desirable sources of said digital information in which keyword terms are found are selectably added to said visit list whereby a user may selectably initiate and alter searches for specific keywords on topics potentially useful to said user, including roadside service locations and other searches, while substantially utilizing said digital information executing on said computer.

* * * * *

US005721421A

United States Patent [19]

VanDonkelaar

[11] Patent Number: 5,721,421

[45] Date of Patent: Feb. 24, 1998

[54] **APPARATUS AND METHOD FOR VERIFYING A SHELF TAG**

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[73] Assignee: **Bass, Inc.**, Dayton, Ohio

[21] Appl. No.: **680,439**

[22] Filed: **Jul. 15, 1996**

[51] **Int. Cl.**[6] **G06K 7/10**

[52] **U.S. Cl.** **235/462**; 235/472

[58] **Field of Search** 235/462, 472

[56] **References Cited**

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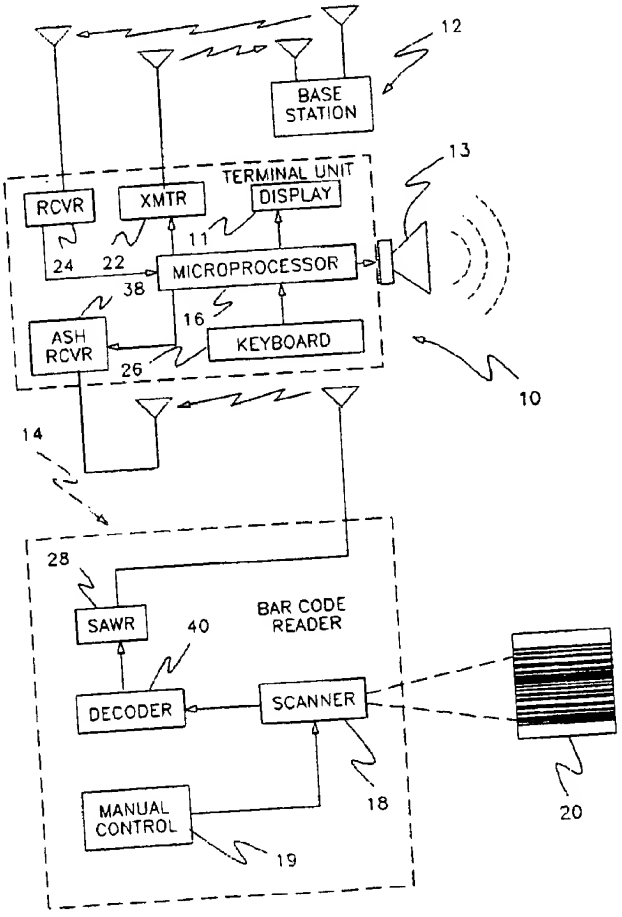
Primary Examiner—F. L. Evans

Attorney, Agent, or Firm—Biebel & French

[57] **ABSTRACT**

A shelf tag verifying apparatus having a portable terminal unit in radio communication with a base station and in acoustic wave communication with a nearby bar code reader. The bar code reader reads a bar code printed upon a product which rests upon shelving marked by a tag requiring verification. A decoder mounted within the bar code reader generates a binary product code corresponding to the bar code and appends a check code. A SAWR transmitter then transmits the binary product code and the check code to an ASH receiver mounted in the terminal unit. A microprocessor mounted in the terminal unit verifies the check code and generates a query for radio transmission to the base station, whereupon the base station responds with information for verification of the shelf tag.

8 Claims, 3 Drawing Sheets



06/06/2003, EAST Version: 1.03.0002

FIG-1

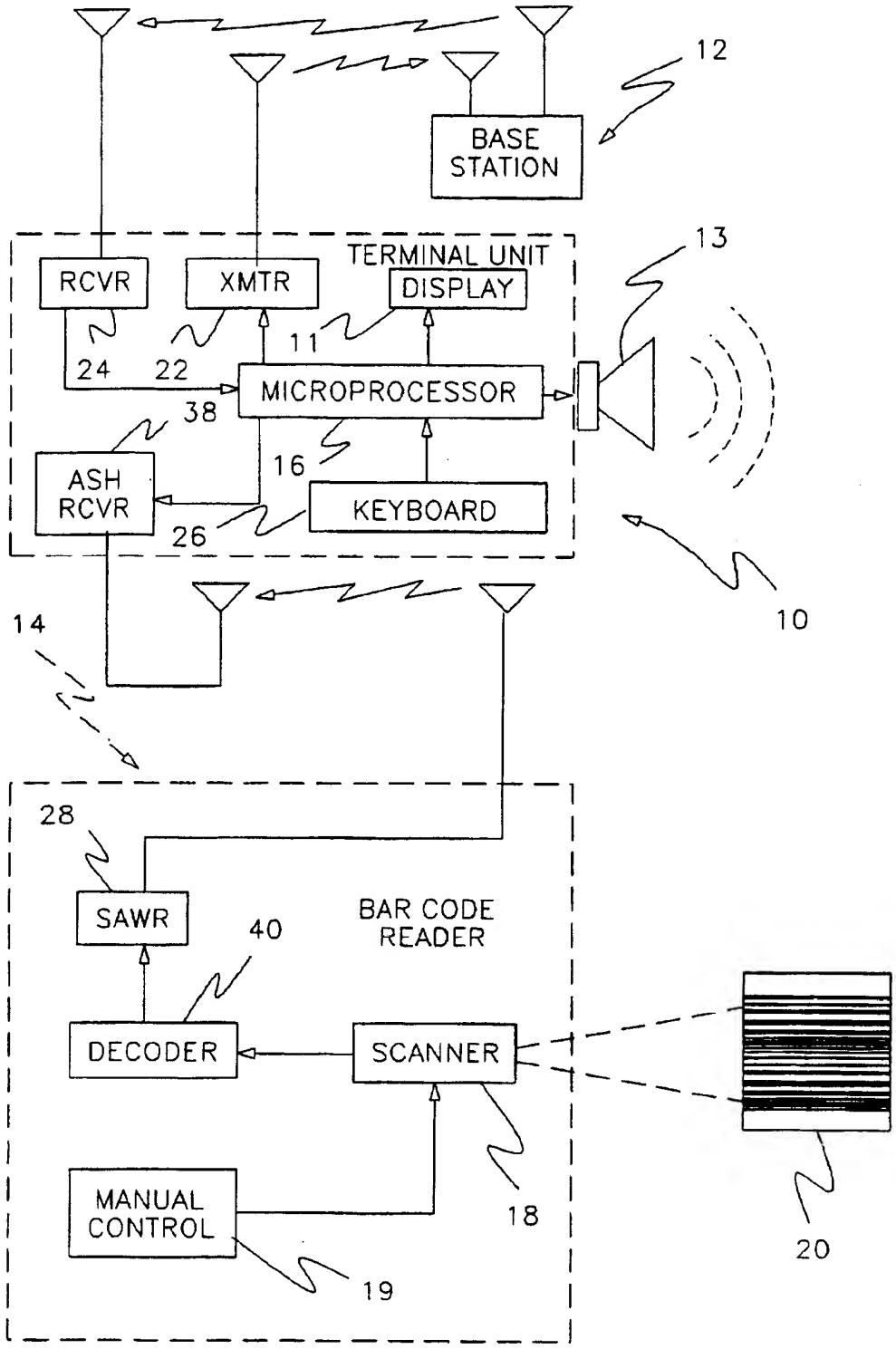
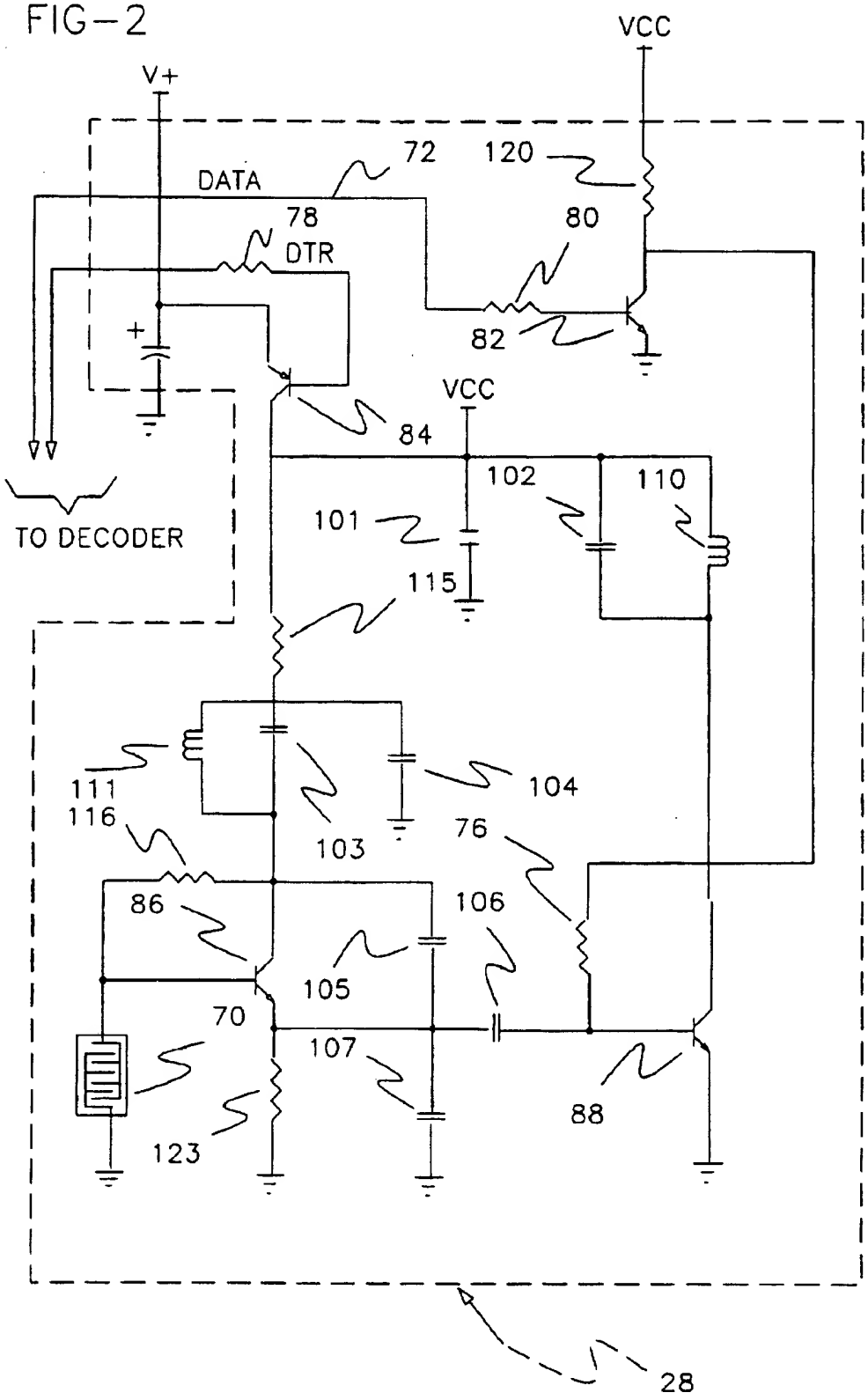

12
BASE STATION
13
TERMINAL UNIT
RCVR
XMTR
DISPLAY
11
24
22
MICROPROCESSOR
38
16
ASH RCVR
KEYBOARD
26
10
14
28
SAWR
BAR CODE READER
40
DECODER
SCANNER
MANUAL CONTROL
18
19
20

FIG-2


VCC
V+
72
120
DATA
78
DTR
80
82
VCC
84
102
110
101
TO DECODER
115
111
116
104
103
76
86
106
105
70
107
88
123
28

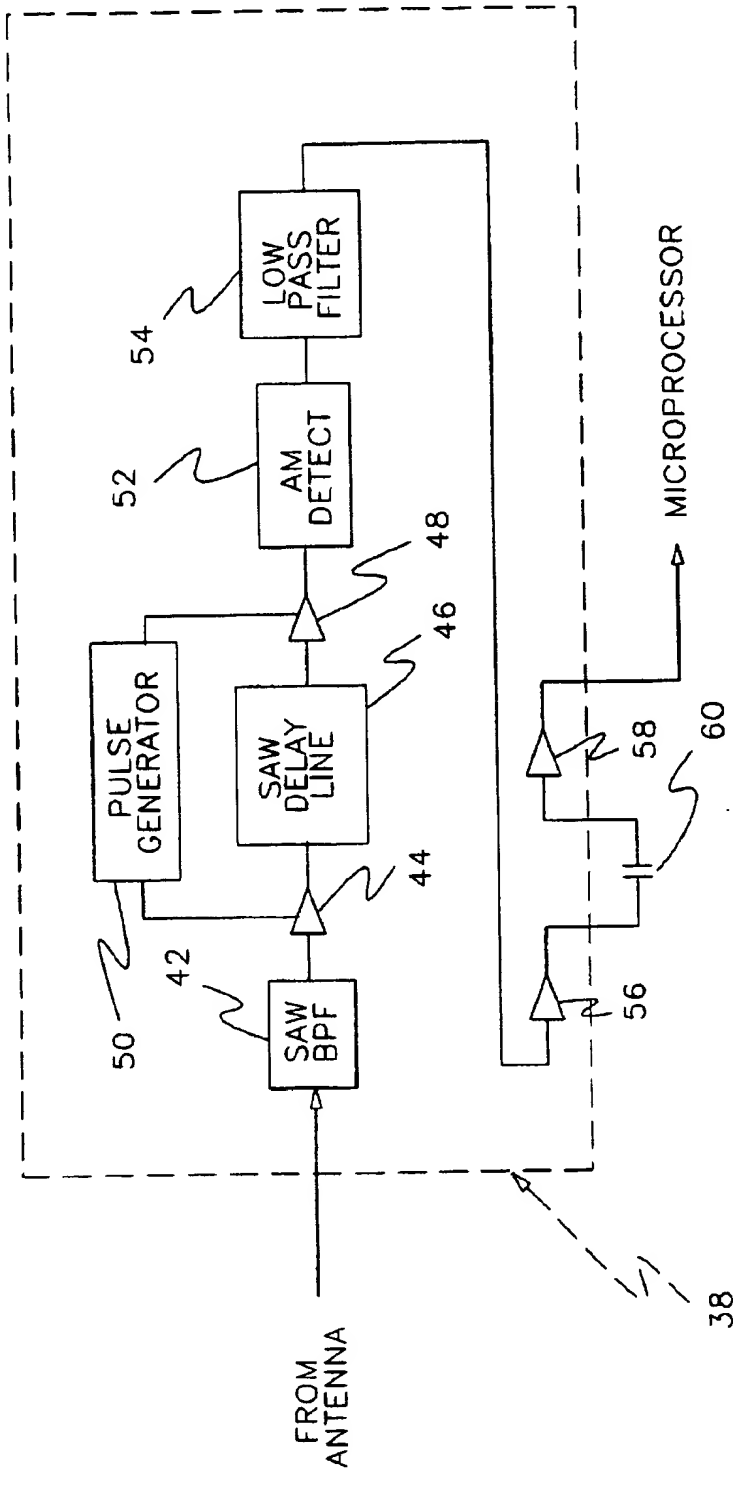

LOW PASS FILTER
54
AM DETECT
52
48
46
PULSE GENERATOR
SAW DELAY LINE
MICROPROCESSOR
58
60
44
42
50
SAW BPF
56
FROM ANTENNA
38

FIG-3

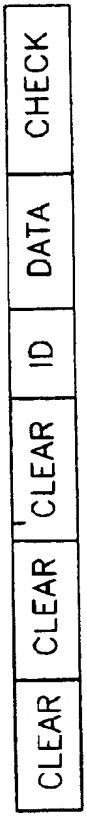

125
CLEAR
CLEAR
CLEAR
ID
DATA
CHECK

FIG-4

APPARATUS AND METHOD FOR VERIFYING A SHELF TAG

BACKGROUND OF THE INVENTION

This invention relates to the field of retail merchandising and more particularly to apparatus for verifying human readable information upon shelf tags.

In times past retail stores, particularly food markets, marked prices upon every item stocked on merchandising shelves. Customers were accustomed to reading the prices marked upon the products and comparing those prices against cash register receipts to verify the accuracy of the bill. However, in recent times there has developed a practice of printing bar codes upon nearly all types of packaged products. Such bar codes uniquely identify the products upon which they are placed and are positioned on the package in such a manner as to facilitate reading by scanners at point-of-sale terminals. Stores which are equipped with such terminals will relay the scanned bar codes to a central computer. This provides pricing information which is sent back to the inquiring terminal. Such merchandising requires no price marking on the product being sold, and therefore many stores have discontinued price marking all together. Consequently it has become necessary to provide shelf tags which display product identifying information and associated prices, all in human readable form. These shelf tags are easily damaged, moved or lost and are quickly outdated due to frequent price changes.

It will be appreciated that means must be provided for quickly verifying shelf tag information. Therefore stock clerks are issued bar code readers which are connected by cables to portable terminal units. A typical terminal unit has an internally mounted microprocessor and is equipped for radio communication with a base station located near the central computer. When a stock clerk wishes to verify a price appearing on a shelf tag, he uses his bar code reader to scan a bar code on one of the products in question. This generates a bar code sensing signal which is sent to the terminal unit. The microprocessor decodes the bar code sensing signal to create a corresponding binary code. This binary code is incorporated into a query which the terminal unit transmits to the base station for forwarding to the central computer. After the central computer receives the query, it checks a data base of pricing information and formulates a responsive message containing the requested price. That message is sent to the base station and relayed to the terminal unit for presentation on a built-in visual display.

During the course of a long work day a typical stock clerk may scan hundreds of bar codes, each time pulling the cable which connects his bar code reader to his terminal unit. This requires extra effort on the part of the stock clerk, due to three contributing factors. First there is the weight of the cable itself. Secondly there is the stiffness of the cable which resists the bending required for accommodating a lateral scan across a package label. Thirdly there are the frictional forces which are encountered whenever the cable drags across a shelf or other surface. While prior art, such as Worthington et. at. U.S. Pat. No. 5,365,050, suggests the use of low power cordless bar code scanners, such scanners transmit low power RF signals which are amplitude modulated by voltages from the scanning sensor. Most bar codes of current interest use the UPC format wherein numeric characters are represented by 2 light bars and two dark bars of varying widths. The entire bar code reading process involves sensing the varying light levels across the alternating light and dark bars, and transforming the light level variations into 8-bit binary codes.

The scanning process itself is quite noisy due to variations in: laser beam intensity, laser beam geometry, scanning direction, scanning speed, accuracy of printed bar widths, light bar reflectivity, dark bar reflectivity and foreign matter presence on the package. This degrades the digitizing process and may in certain circumstances make bar code reading quite difficult. However, the prior art cordless wand compounds the problem by adding RF noise to the scanning signal. Consequently the trade has generally steered clear of cordless wands and has endured the inconvenience of a cable or cord connection between the bar code scanner and the portable remote terminal or, alternatively, has incorporated the scanner into the terminal itself. However, this merely trades one set of problems for another. The integrated unit is considerably heavier than the bar code reading device alone, and while the clerk no longer has to drag a cord, the arms and wrists now have to manipulate a lot of weight while performing a bar code scan. It can be seen that there is a need for an improved shelf tag verification system.

SUMMARY OF THE INVENTION

This invention eliminates inconveniences associated with prior an shelf tag verification systems by transmitting bar codes from a bar code reader to a portable remote terminal in a binary coded format. The bar code reader includes a scanner for manually controlled scanning of printed bar codes, a decoder for decoding and digitizing output voltage levels from the scanner and a surface acoustic wave resonator for wireless transmission of output signals from the decoder to the portable remote terminal unit. A check code is also transmitted for verification of the signal. The portable remote terminal has an amplifier sequenced hybrid receiver for receiving output signals from the decoder and a microprocessor which checks the integrity of the received signals. When an accurate transmission is received, it is relayed by radio transmission to a base station. The base station forwards the transmission to a host computer which checks an information file, indexed according to bar codes, and routes the current product price or other appropriate information back to the portable remote terminal.

Accordingly, it is an object of the invention to provide an improved apparatus and method for verifying alphanumeric information appearing on tags affixed to shelving for bar coded products.

It is another object of the invention to enable improved verification of bar codes imprinted upon products.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a schematic illustration of a shelf tag verifying system according to the present invention.

FIG. **2** is a schematic illustration of a surface acoustic wave resonator.

FIG. **3** is a schematic illustration of an amplifier-sequenced hybrid receiver.

FIG. **4** is a schematic illustration of a signal sent from a bar code scanner to a terminal unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A shelf tag verifying system in accordance with the present invention may be configured as generally illustrated in FIG. **1**. The system comprises a terminal unit **10** in

communication with a bar code reader **14**. Terminal unit **10** also communicates with a base station **12**. Base station **12** is in communication with a host computer (not illustrated) which stores product information responsive to queries generated by terminal unit **10**.

Terminal unit **10** comprises a microprocessor **16** which receives operator input from a keyboard **26** and which is connected for communication with an amplifier-sequenced hybrid (ASH) receiver **38**, a radio transmitter **22**, a radio receiver **24** and an indicating device **11** which may be a liquid crystal display, voice synthesizer or other unit capable of generating an indication recognizable by a human operator. Also shown on FIG. **1** is an audio unit **13** which generates a "beep" or other distinctive sound to indicate successful reception of a scanning signal from bar code reader **14**. ASH receiver **38** receives binary coded radio signals corresponding to a bar code printed upon a label **20** and scanned by a scanner **18** mounted within bar code reader **14**. Scanner **18** preferably comprises a laser, a power supply, scanning optics and a photodiode sensor, all of which are conventional and none of which are illustrated. Label **20** may be imprinted upon a product package and may identify the contents of the package. Scanner **18** is activated by a manual control **19**, and bar code reader is manually swept along a path which directs a laser beam across label **20**. Alternatively scanner **18** could generate a suitable scanning beam using a light emitting diode and appropriate collimating optics or a light source and CCD sensor.

As the laser beam is swept across label **20**, light energy is reflected back toward scanner **18** and focussed upon the above mentioned photodiode. The photodiode then responds by generating a sensing signal which is amplitude modulated in accordance with variations in the intensity of the backwardly reflected radiation.

The sensing signal is routed from scanner **18** to a decoder **40** which also may be of conventional design. Decoder includes a threshold device, not illustrated, which converts the sensing signal into a simple square wave representing dark-to-light and light-to-dark transitions. A timing circuit examines the times between transitions and categorizes each bar into one of four possible widths. A simple logic arrangement examines the widths of bars in side-by-side bar groups (two light bars and two dark bars per group) and generates corresponding a binary product code in 8-bit bytes (ASCII format). The binary product code is then formatted into a transmission signal **125**, as illustrated in FIG. **4** and thereafter used for ON/OFF modulation of an RF signal generated by a surface acoustic wave resonator circuit **28**.

When the binary product code is received by ASH receiver **38**, it is sent to microprocessor **16** and passed to transmitter **22** for transmission to base station **12**. Base station **12** then forwards the code to a host computer (not illustrated) which uses it for entry into a data base of product information. This enables the host computer to prepare an informational message regarding the product for routing back to microprocessor **16** via base station **12** and receiver **24**. Microprocessor **16** causes the message to be presented on display **11**, so that the stock clerk may verify a shelf tag associated with the product.

As described in more detail below surface acoustic wave resonator **28** may generate radio signals at a frequency of 433.92 MHz. This frequency may be used at low power without a license from the government. A suitable resonator for such purposes is available from RF Monolithics, Inc. under part number R02101A. The signal generated by surface acoustic wave resonator **28** travels only a relatively short distance to reach terminal unit **10**, typically less than about 10 feet.

The signal radiated by resonator **28** is received by amplifier sequenced hybrid receiver **38** which preferably may be a device of the type sold by RF Monolithics, Inc. under part number RX1020. All communications between resonator **28** and receiver **38** are on a simplex basis. That is, resonator **28** merely transmits signals without any indication of reception by receiver **38**.

In normal operation the signals transmitted by resonator **28** may become degraded or corrupted for any of numerous reasons. Therefore decoder **40** performs a cyclic redundancy check (CRC) to generate a 16-bit check code. This involves an integer arithmetic operation wherein a binary polynomial is formed from the bits of the binary product code. This polynomial is divided by a predetermined 16-bit binary reference number, and the remainder is used as the check code. The division my be performed by placing the binary coefficients of the polynomial into a 16-bit wide shift register and repeatedly subtracting the predetermined reference number until a remainder is obtained. Hardware for performing such subtraction may comprise **16** parallel subtraction circuits, each consisting of an arrangement of 9 NAND gates. Such hardware is well known and need not further be described. Alternatively such a CRC check code could be produced by a microprocessor using software as described in a reference manual entitled "Asynchronous Communications Library for C" available from Greenleaf Software, Inc. of Dallas, Tex.

The information signal **25** modulates the RF signal generated by SAWR **28**, so the binary product code and the check code are sent to ASH receiver **38**. Microprocessor **16** stores the binary product code in a random access memory and uses it to calculate a 16-bit verifying code as a check against the check code appended to the transmitted data. If the check is successful, the Microprocessor **16** activates audio unit **13** to generate a beep and also transmits the product code to base station **12**.

The details of resonator **28** are shown in FIG. **2**. The key element of resonator **28** is a chip **70** which generates surface waves at a frequency of 433.92 MHz. Chip **70** is enabled by a DTR signal applied to line **74**. The DTR signal is applied to a resistor **78** connected to the base of a transistor **84**. The DTR signal causes transistor **84** to become conductive and supply current through a resistor **115** to an oscillation circuit comprising a transistor **86**, resistors **116**, **123** and capacitors **105**, **107**. This excites oscillations at a frequency of 433.92 MHz in transistor **86** and creates an alternating drive signal for the chip **70**.

Data signals in the form of a series of zeros and ones are applied by decoder **40** to line **72** of resonator circuit **28**. These data signals are applied through a resistor **80** to the base of a transistor **82**. Transistor **82** is connected to a VCC supply through a resistor **120** and inverts the sign of the data appearing on data line **72**. The inverted signal controls ON/OFF current conduction through transistor **88**, which in turn applies a binary modulation envelope to the high frequency surface waves being generated by chip **70**. Signal filtering is provided by capacitors **101**, **102**, **103**, **104** and **106** and coils **110**, **111** to line **72** of resonator circuit **28**.

As previously stated, data signals appearing on line **72** are inverted before modulating the RF signal produced by circuit **70**. The modulated signal is received by receiver **38** and again inverted in the process. This produces control signals for microprocessor **16** which have the same boolean sense as the control signals on line **72**.

Referring now to FIG. **3**, modulated signals received from resonator **28** are connected to a surface acoustic wave device **42** connected for use as a band pass filter **42**. Output signals from band pass filter **42** are applied to an RF amplifier **44** which is turned on by a pulse generator **50**. The output of RF amplifier **44** is applied to the input of a surface acoustic wave delay line **46**. When the signal emerges from delay line **46**, then pulse generator **50** turns off RF amplifier **44** and

turns on a second RF amplifier **48**. Output signals from second RF amplifier **48** are applied to an AM detector **52** and then are filtered by a low pass filter **54**. This removes the carrier frequency and provides a baseband output which is amplified by an amplifier **56**. The baseband output signal from amplifier **56** is raw demodulated, unprocessed data. The level of this data is dependant upon the input RF level. This signal is capacitively coupled via a capacitor **60** to the input of a comparator **58** and then is relayed to microprocessor **16** for initiation of an information exchange which will enable verification of a shelf tag.

As described above, the invention has application to a supermarket environment. However, it will be appreciated that it may be used in warehouses and in other settings involving high volume hand manipulation of a product code sensor.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. Shelf tag verification apparatus comprising:

(a) a portable product code reader including:

(1) a scanner for scanning a product marked by a machine readable identifying code and generating an analog signal corresponding to light and dark gradations thereof,

(2) a decoder connected to said scanner for receiving said analog signal, generating a corresponding binary product code, and calculating a check code based upon said binary product code and a predetermined reference code,

(3) a surface acoustic wave resonator connected for generating a radio frequency signal and using said binary product code and said check code to modulate said radio frequency signal; and

(b) a hand-held terminal unit including:

(1) an amplifier sequenced hybrid receiver for receiving said radio frequency signal and reproducing said binary product code and said check code,

(2) a microprocessor connected to said amplifier sequenced hybrid receiver for receiving said binary product code, calculating a verifying code therefor, comparing said verifying code against said check code and unloading said binary product code in the event of a satisfactory check,

(3) a radio transmitter connected for receiving said binary product code from said microprocessor and transmitting a corresponding radio signal to a base station,

(4) a radio receiver for receiving a responsive radio transmission from a base station and supplying said responsive radio transmission to said microprocessor, and

(5) an indicating device connected to said microprocessor for creating an indication of said responsive radio transmission in a form recognizable to a human operator.

2. Apparatus according to claim **1** further comprising an audio unit mounted in said terminal unit for generating an audio signal to indicate successful verification of said binary product code by said microprocessor.

3. Apparatus for product identification comprising:

(a) a scanner for scanning a product marked by a machine readable identifying code and generating an analog signal corresponding to light and dark gradations thereof,

(b) a decoder fixed to said scanner for receiving said analog signal and generating a corresponding binary product code and a check code therefor,

(c) a surface acoustic wave resonator connected for receiving said binary product code and said check code and radiating a corresponding radio frequency message,

(d) an amplifier sequenced hybrid receiver for receiving said radio frequency message, and

(e) a microprocessor for verifying said check code and selectively processing said binary product code when said check code is satisfactorily verified.

4. Apparatus according to claim **3** further comprising a radio transmitter connected for receiving said binary product code from said microprocessor and transmitting a corresponding radio signal to a base station.

5. Apparatus according to claim **4** further comprising an audio unit for generating a distinctive sound when said microprocessor has verified said check code.

6. A method of verifying information printed on a shelf tag comprising the steps of:

(1) generating a bar code signal by sweeping a bar code sensor across a bar code imprinted upon a package associated with said shelf tag,

(2) generating a binary product code by decoding said bar code signal,

(3) using said binary product code and a predetermined reference code to generate a check code,

(4) causing a surface acoustic wave resonator to radiate a radio frequency signal,

(5) using said binary product code and said check code to modulate said radio frequency signal,

(6) at a vicinity adjacent said shelf tag, receiving said radio frequency, modulated as aforesaid,

(7) at said vicinity, recovering said binary product code and said check code by demodulating said radio frequency signal,

(8) at said vicinity, using said binary product code, recovered as aforesaid, and said predetermined code to generate a verifying code,

(9) at said vicinity, verifying said check code, recovered as aforesaid, by comparison against said verifying code,

(10) transmitting said binary product code, recovered as aforesaid, from said vicinity to a base station, only in the event that said verifying step produces a result previously determined to be satisfactory,

(11) using said binary product code, recovered and transmitted as aforesaid, to create a message relating to said package,

(12) transmitting said message from said base station to said vicinity, and

(13) displaying said message at said vicinity.

7. Method according to claim **6** wherein a cyclic redundancy check is performed for generation of said check code and said verifying code.

8. Method according to claim **7** further comprising the step of signaling satisfactory performance of said verifying step by generating an audible signal.

* * * * *

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Swintek

[11] Patent Number: 5,528,025

[45] Date of Patent: Jun. 18, 1996

[54] **APPARATUS AND METHOD FOR THE WIRELESS EXCHANGE OF BAR CODE DATA**

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[21] Appl. No.: **315,585**

[22] Filed: **Sep. 30, 1994**

[51] **Int. Cl.**[6] **G06K 7/10**

[52] **U.S. Cl.** **235/472**; 235/375

[58] **Field of Search** 235/472, 375; 375/1

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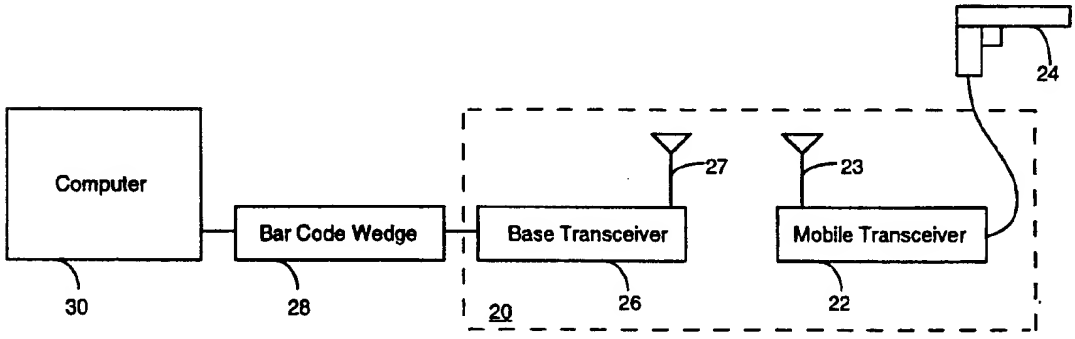
Primary Examiner—Harold Pitts

Attorney, Agent, or Firm—Flehr, Hohbach, Test, Albritton & Herbert

[57] **ABSTRACT**

A retrofit apparatus is connected to an existing bar code inventory system that includes a bar code corresponding to bar code markings, a bar code wedge to reader to generate a set of digital output signals transform the digital output signals into corresponding computer data characters, and a computer connected to the bar code wedge to process the computer data characters. A mobile transceiver is connected to the bar code reader. The mobile transceiver transmits wireless bar code signals corresponding to the digital output signals from the bar code reader. A receiver in the mobile transceiver is activated for a predetermined period of time after the wireless bar code signals are transmitted. A base transceiver is connected to the bar code wedge to receive the wireless bar code format output signals and to link them to the computer through the bar code wedge. If the computer receives a valid signal, it generates an acknowledge signal that is passed through the bar code wedge to the base transceiver. The base transceiver transmits a corresponding wireless acknowledge signal. The mobile transceiver receives the wireless acknowledge signal during the predetermined period that the receiver is activated. The bar code reader is powered by the mobile transceiver and the base transceiver is powered by the bar code wedge.

11 Claims, 4 Drawing Sheets



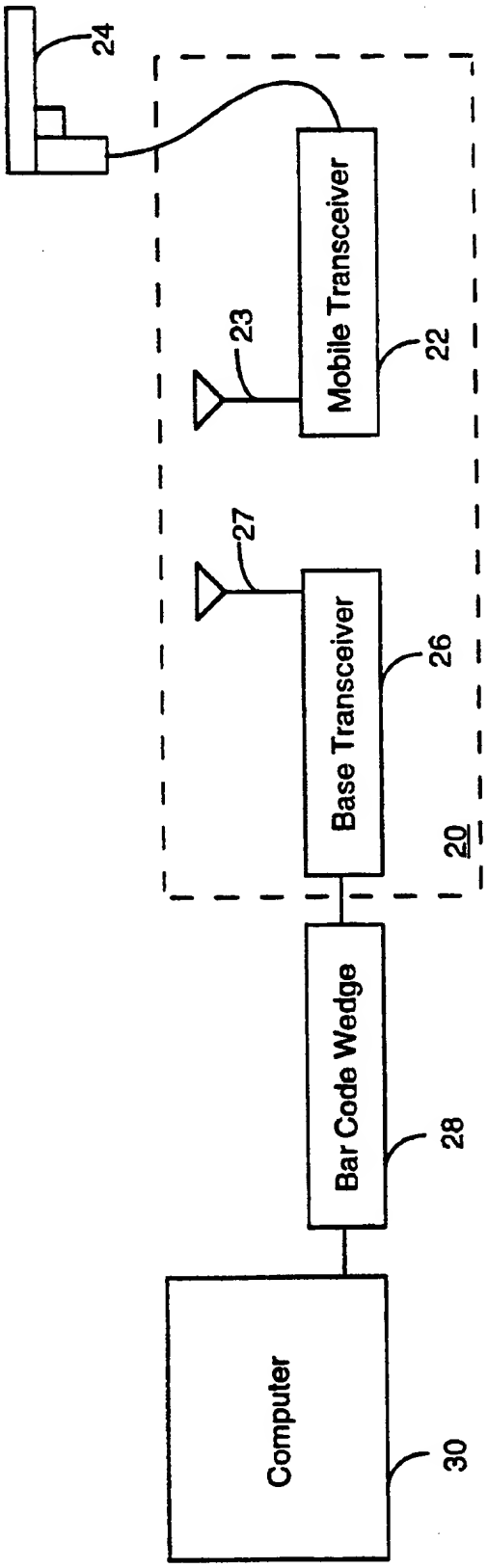

24
Mobile Transceiver
23
22
27
Base Transceiver
26
20
Bar Code Wedge
28
Computer
30

Figure 1

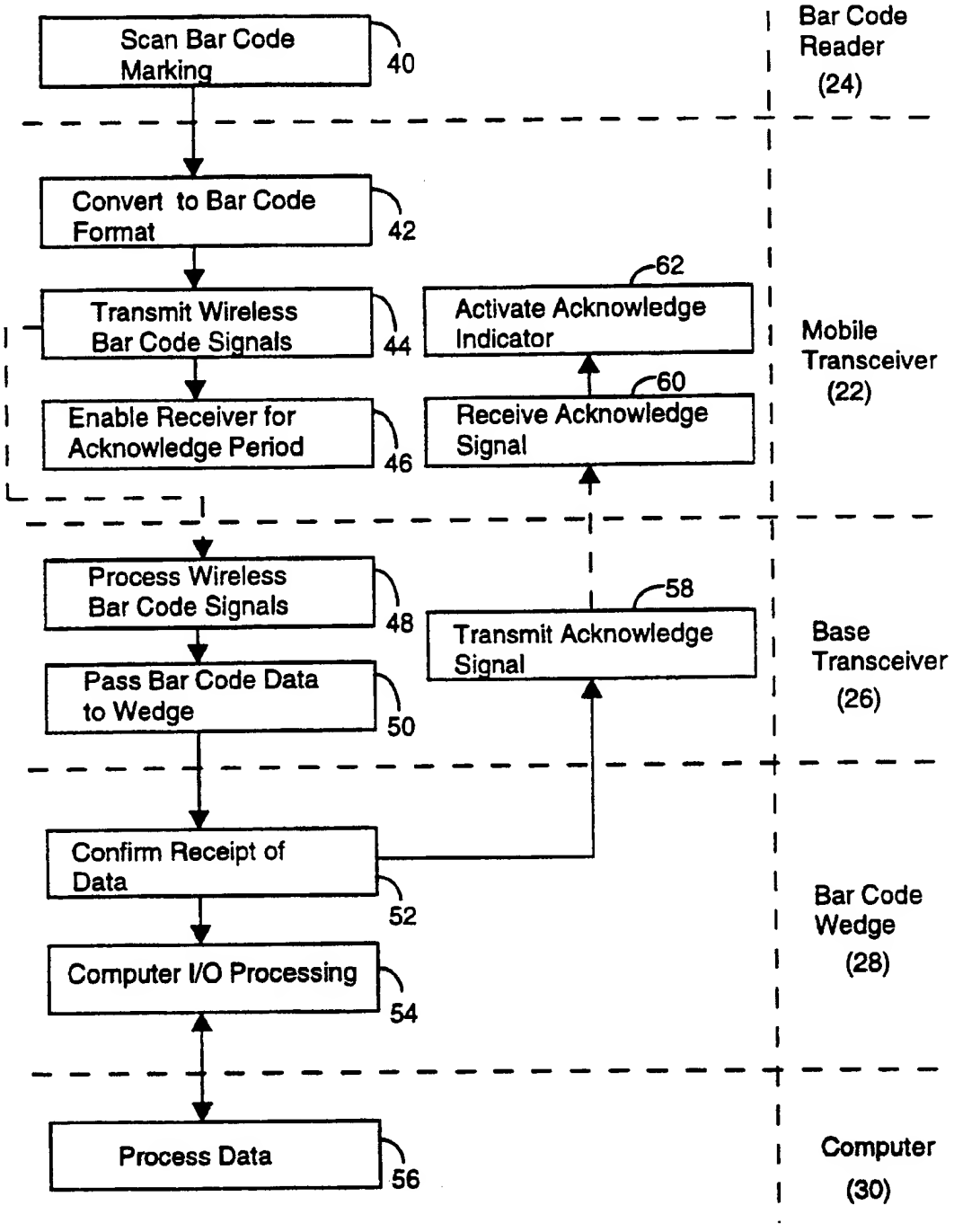

Scan Bar Code Marking
40
Convert to Bar Code Format
42
Transmit Wireless Bar Code Signals
44
Enable Receiver for Acknowledge Period
46
Process Wireless Bar Code Signals
48
Pass Bar Code Data to Wedge
50
Confirm Receipt of Data
52
Computer I/O Processing
54
Process Data
56
Receive Acknowledge Signal
60
Activate Acknowledge Indicator
62
Transmit Acknowledge Signal
58
Bar Code Reader (24)
Mobile Transceiver (22)
Base Transceiver (26)
Bar Code Wedge (28)
Computer (30)

Figure 2

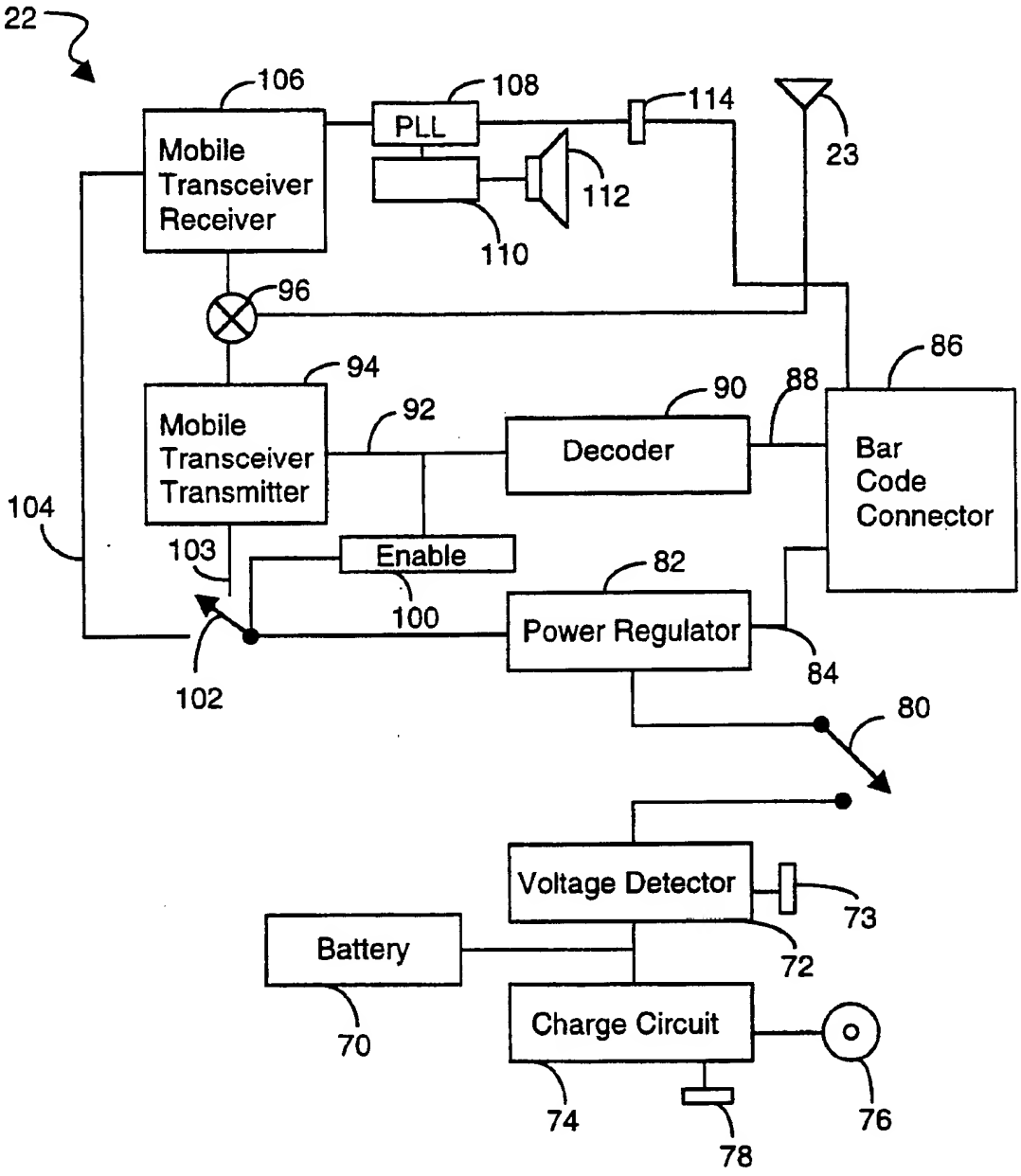

22
106
108
114
PLL
Mobile
Transceiver
Receiver
23
112
110
96
86
94
88
90
92
Mobile
Transceiver
Transmitter
Decoder
Bar
Code
Connector
104
103
Enable
82
100
Power Regulator
102
84
80
Voltage Detector
73
Battery
72
Charge Circuit
70
74
78
76

Figure 3

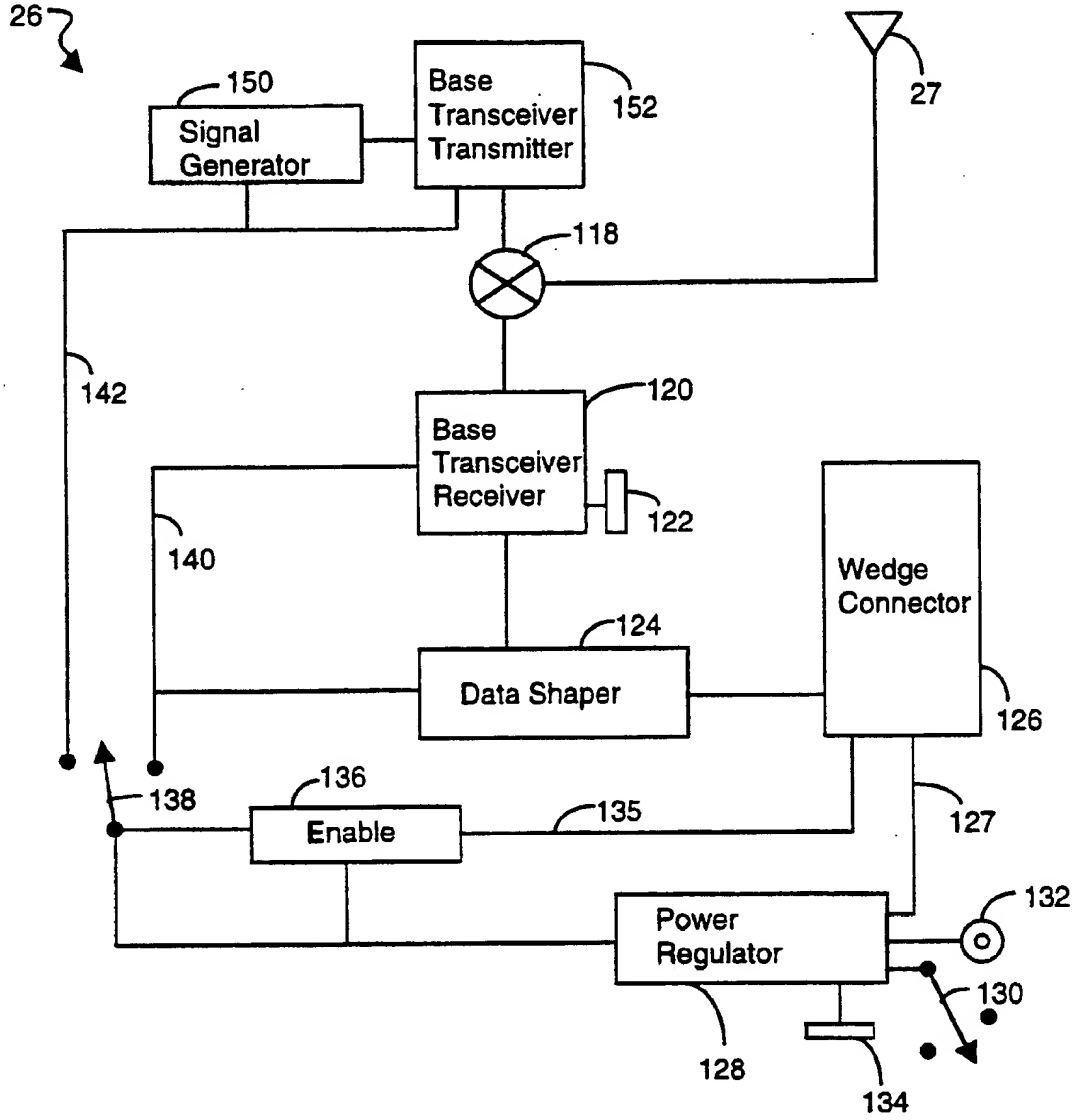

26
150
Signal Generator
Base Transceiver Transmitter
152
27
118
142
120
Base Transceiver Receiver
122
140
Wedge Connector
124
Data Shaper
126
136
138
Enable
135
127
132
Power Regulator
130
128
134

Figure 4

APPARATUS AND METHOD FOR THE WIRELESS EXCHANGE OF BAR CODE DATA

BRIEF DESCRIPTION OF THE INVENTION

This invention relates generally to bar code inventory systems. More particularly, this invention describes an apparatus and method to retrofit existing bar code inventory systems for the wireless exchange of bar code data.

BACKGROUND OF THE INVENTION

Bar code inventory systems are known in the art. These systems process bar code data that are affixed to different types of objects, such as product packages. The bar code data includes a set of vertical lines of varying widths. A bar code inventory system includes a bar code reader, such as a light pen or scan gun, that transforms the vertical lines (printed bars and spaces between them) of the bar code label into a set of digital high and low pulses of varying duration, corresponding to the varying widths of the vertical lines of the bar code label.

Known stationary bar code inventory systems include an interface device, also often called a bar code wedge in the industry, that is connected between the bar code reader and a computer. The bar code wedge is typically tethered to the bar code reader by a flexible electrical cord. This allows an individual to move the bar code reader to any position within the range of the flexible cord. The information obtained from the bar code reader is transmitted through the flexible electrical cord to the bar code wedge. The bar code wedge transforms the information into a character set, such as ASCII, that may be processed by a computer. Connection between the bar code wedge and the computer may be accomplished through a serial port of the computer or through a keyboard input port.

A shortcoming of prior art bar code inventory systems is that they are not readily portable. That is, the computer and bar code wedge of the system mitigate against portable operation of the system. Some portability is afforded by the bar code reader being attached to the wedge with a flexible electrical cord. However, the length of such a cord has practical limits. For example, if one is using a bar code inventory system in a warehouse, a long flexible electrical cord may create a hazard for individuals working in the warehouse. In addition, a long flexible electrical cord will also be susceptible to damage from equipment, such as fork lifts, operating in the warehouse.

Consequently, it would be highly desirable to provide a bar code inventory system that is not positionally constrained by a physically tethered bar code reader. Such a system would preferably provide instantaneous communication between a bar code reader and a base computer. In such a configuration, the bar code reader could rely upon immediate feedback from the base computer and therefore operate as a tethered bar code reader. Ideally, such a system would operate with existing bar code inventory systems and thereby not necessitate the costly replacement of one bar code inventory system for another.

SUMMARY OF THE INVENTION

The invention is a retrofit apparatus for connection to an existing bar code inventory system that includes a bar code reader to generate a set of output signals corresponding to bar code markings, a bar code wedge (an interface device) to transform the output signals into corresponding computer data characters, and a computer connected to the bar code wedge to process the computer data characters. In keeping with the invention, a mobile transceiver is connected to the bar code reader. The mobile transceiver transmits wireless bar code signals corresponding to digital output signals received from the bar code reader. The wireless bar code signals constitute a self-correcting code. That is, the output of the bar code reader has a constant ratio of mark and space elements. If the information that is processed does not have the proper ratio, it is presumed to be erroneous. Because of this error checking, it is more reliable than standard ASCII and packet transmitters operating under radio frequency interference conditions. Thus, with the wireless bar code format of the invention, traditional wireless communication handshakes, check bits, or other protocols are not required.

A receiver in the mobile transceiver is activated for a predetermined period of time after the wireless bar code signals are transmitted. A base transceiver is located to receive the wireless bar code format output signals and to link them to a computer through a bar code wedge if a valid signal is received. The wedge generates an acknowledge signal that is passed to the base transceiver. The base transceiver transmits a corresponding wireless acknowledge signal. The mobile transceiver receives the wireless acknowledge signal during the predetermined period that its receiver is activated. The bar code reader is powered by the mobile transceiver and the base transceiver is powered by the bar code wedge.

The apparatus allows un-tethered freedom for the bar code reader. The apparatus provides instantaneous communication between the bar code reader and the base computer. Consequently, the bar code reader effectively operates as a tethered device. The retrofit nature of the apparatus allows it to be used with existing bar code inventory systems and thereby provides an improved system without the expense of replacing the existing system.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the nature and objects of the invention, reference should be made to the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** illustrates a preferred embodiment of the retrofit wireless bar code data exchange apparatus of the invention.

FIG. **2** illustrates the method of operation of the apparatus of FIG. **1**.

FIG. **3** illustrates the mobile transceiver of the apparatus of FIG. **1**.

FIG. **4** illustrates the base transceiver of the apparatus of FIG. **1**.

Like reference numerals refer to corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of the retrofit wireless bar code data exchange apparatus **20** of the invention is illustrated in FIG. **1**. The apparatus **20** includes a mobile transceiver **22** with an antenna **23**. The mobile transceiver **22** is connected to a bar code reader **24**. Digital output signals from the bar code reader **24** are processed by the mobile transceiver **22** which then transmits wireless bar code signals corresponding to the digital output signals from the bar code reader **24**.

The apparatus **20** also includes a base transceiver **26** with an antenna **27**. The base transceiver **26** receives the wireless bar code signals transmitted from the mobile transceiver **22** and conveys the signals, by a physical electrical connection, to a bar code wedge **28**. The bar code wedge **28** generates computer data characters that are passed to a computer **30** for processing in a conventional manner.

Bar code inventory systems of the prior art have a direct physical connection between the bar code wedge **28** and the bar code reader **24**. The present invention uses standard connectors so that the prior art physical connection between the bar code wedge **28** and the bar code reader **24** is replaced by a physical connection between the mobile transceiver **22** and the bar code reader **24**, and a physical connection between the bar code wedge **28** and the base transceiver **26**. This feature allows the seamless integration of the apparatus of the invention into an existing bar code inventory system. That is, the connections of an existing bar code inventory system are used with a preferred embodiment of the invention. Moreover, existing bar code inventory systems will operate in the same manner, except for the feature that there is no longer a physical connection between the bar code wedge **28** and the bar code reader **24**. It should be appreciated that such an arrangement provides greater flexibility in the use of the bar code reader **24**. That is, the mobile transceiver **22** does not have to be tethered to the bar code wedge **28**. Additional benefits associated with the system include a feature wherein the bar code reader **24** may be powered from the mobile transceiver **22** and the base transceiver **26** may be powered from the bar code wedge **28**.

The general nature and advantages of the invention have now been described. Attention presently turns to a more detailed discussion of the method and apparatus of the invention.

FIG. **2** illustrates the processing steps associated with a bar code inventory system that incorporates the preferred embodiment of the retrofit wireless bar code data exchange apparatus of the invention. The figure illustrates the operation performed by each component associated with a bar code inventory system.

A bar code reader **24** is used to scan bar code markings to produce digital output signals (block **40**). The digital output signals are passed to the mobile transceiver **22**. The mobile transceiver **22** initially converts the digital output signals to bar code format signals (block **42**). Most existing bar code inventory systems use a bar code reader **24** that provides digital signals that are not in a bar code format. Thus, the mobile transceiver **22** of the invention provides the required conversion of the digital signals to a bar code format. However, it should be appreciated that the invention is equally applicable to a bar code reader **24** that provides bar code format signals. Bar code format signals are critical to the wireless transmission operations of the invention, as will be described below.

In either embodiment, the next operation performed by the mobile transceiver **22** is to transmit wireless bar code signals corresponding to the bar code format signals (block **44**). After this operation is executed, a receiver within the mobile transceiver **22** is enabled for a predetermined period of time to receive an acknowledge signal (block **46**).

The transmitted wireless bar code signals are processed by the base transceiver **26** (block **48**). The signals are then passed in a standard format to the bar code wedge **28** (block **50**). The bar code wedge **28** generates an acknowledgement signal (block **52**) that is passed back to the base transceiver **26**. The bar code wedge **28** also performs standard computer input/output processing (block **54**) by converting the bar code signals to a known character set, such as ASCII or an integer set. The computer **30** then processes the character set (block **56**).

As previously indicated, a confirmation signal is sent from the bar code wedge **28** to the base transceiver **26**. Thereafter, the base transceiver **26** transmits a wireless acknowledge signal (block **58**).

The acknowledge signal is received by the mobile transceiver **22** (block **60**) during the predetermined period of time that the receiver of the mobile transceiver **22** is activated. Finally, an acknowledge indicator on the mobile transceiver **22** is activated (block **62**) so that the operator of the bar code reader knows that the bar code wedge **28** has received valid data for computer **30**.

The methodology disclosed in FIG. **2** is particularly advantageous because the bar code format itself has a constant ratio of mark and space elements that is transmitted. Consequently, a complicated communication protocol is not required between the mobile transceiver **22** and the base transceiver **26**. That is, the bar code format is self-correcting. If the base transceiver does not receive a valid bar code signal, then an acknowledgement is never sent back to the mobile transceiver **22**. Unlike serial ASCII or packet protocols, no additional communication handshakes, check bits, or other information exchange is required.

Attention now turns to the apparatus of the invention. FIG. **3** illustrates an embodiment **22** of a mobile transceiver incorporating the invention. The mobile transceiver **22** is powered by a battery **70**. Preferably, the battery **70** is accompanied by a voltage detector **72** that has an associated voltage detector indicator **73** to identify when there is a low charge on the battery **70**. In a preferred embodiment, the mobile transceiver **22** also includes a charge circuit **74** with an associated external charge interface **76** and charge circuit indicator **78**. The external charge interface **76** is used to provide an external connection to a power source that is used to re-charge the battery **70**.

A power switch **80** is used to electrically couple the battery **70** to the remaining portions of the mobile transceiver **22**. Specifically, the switch **80** electrically connects the battery **70** to a mobile transceiver power regulator **82**. The power regulator **82** provides a power signal over connector power line **84** to a bar code connector **86**.

Bar code connector **86** is a standard connector that is typically provided at a bar code wedge **28**. A standard D9 connector may be used for this purpose. Using a D9 connector, pin **2** may be designated as a data pin, pin **9** may be designated as a power input, pins **7** and **8** may be designated ground pins, and the remaining pins can be unassigned. Power from the battery **70** is provided through the power regulator **82** over the connector power line **84** to pin **9** of the bar code connector **86**. In this configuration, the bar code reader **24** is powered through the mobile transceiver **22**.

A decoder data line **88** is connected to the data pin of the bar code connector **86**. The decoder **90** uses standard techniques to convert the sequence of varying width digital high and low signals from the bar code connector **86** to bar code format signals. The bar code format signals are then applied to a mobile transceiver transmitter **94** over decoder output line **92**. The mobile transceiver transmitter **94** modulates the bar code format signals on to a radio frequency carrier to produce wireless bar code signals that are passed through a duplex mixer **96** to antenna **23**.

A mobile transceiver enable circuit **100** is triggered by signals on the decoder output line **92**. The enable circuit

drives the mobile transceiver receiver switch **102** from the transmitter power line **103** to the receiver power line **104**. The position of the mobile transceiver receiver switch **102** determines whether the mobile transceiver transmitter **94** or the mobile transceiver receiver **106** receives power from the power regulator **82**.

The mobile transceiver enable circuit **100** connects switch **102** to the receiver power line for a predetermined period of time that is sufficient to receive an acknowledgement signal. Thus, the mobile transceiver receiver **106** is only active for relatively short periods of time.

Preferably, the enable circuit **100** is triggered at the end of a stream of bar code format signals on line **92**. The end of a stream of bar code format signals may be recognized when an extended duration digital high or low signal is observed on the decoder output line **92**, thereby indicating that no data is being generated by the bar code reader. The enable circuit **100** should include a data delay gate to produce a small delay period (approximately 100 milliseconds) to assure switch **102** is not moved before the mobile transceiver transmitter **94** has stopped transmitting wireless bar code signals.

The enable circuit **100** also includes a single-shot timer set to approximately 500 milliseconds. The timer is triggered at the same time as the data delay gate. The timer provides an output strobe that connects the receiver switch **102** and the receiver power line **104** for approximately 400 milliseconds.

The mobile transceiver receiver **106** is connected to a phase-locked loop **108** that is set to the frequency designated for the acknowledge signal. If the receiver **106** picks-up an acknowledge signal, phase-locked loop **108** triggers a tone generator **110** and a good read LED driver **114**. Tone generator **110** activates a speaker **112**. The phase-locked loop signal from the good read LED driver **114** is conveyed to the bar code connector **86** so that a good read LED on the scan gun may be activated.

FIG. 4 illustrates the base transceiver **26** of the invention. The antenna **27** is connected to a duplex mixer **118** that routes the wireless bar code signals to the base transceiver receiver **120**. The operation of the receiver **120** may be identified with a base transceiver receiver indicator **122**. The demodulated signal from the receiver **120** is routed to a data shaper **124**. The data shaper **124** must amplify and hard limit the demodulated signal from receiver **120**. The phase demodulator in receiver **120** is adjusted for the proper phase, whereby its phase is consistent with the pre-transmission bar code signal. The output from the data shaper **124** is then applied to the wedge connector **126**. The wedge connector **126** is preferably a standard D9 connector with designated data, ground, and power pins. The output of the data shaper **124** is applied to the data pin of the wedge connector **126**. From the wedge connector **126**, the data signal is sent through the bar code wedge **28** to the computer **30**.

The power pin of the wedge connector **126** is connected to a wedge connector power line **127** that is connected to a power regulator **128**. In this configuration, when the power switch **130** is turned on, the base transceiver receives its power through the wedge connector **126**, in other words, from the bar code wedge **28**. In the alternative, the power regulator **128** may be supplied through a power plug **132**.

The bar code wedge **28** applies a valid data signal to the wedge connector **126**. The valid data signal is applied to the wedge output line **135**. In response to the valid data signal, a base transceiver enable circuit **136** is triggered. The enable circuit **136** may be implemented as a 500 millisecond on-shot integrated circuit that forces a transmitter enable switch **138** from connection to the receiver power line **140** to connection to the transmitter power line **142**.

The power signal on the transmitter power line **142** activates a signal generator **150** that generates an acknowledge signal that is passed to a base transceiver transmitter **152**. The base transceiver transmitter **152** generates a corresponding wireless acknowledge signal. Processing of the wireless acknowledge signal by the mobile transceiver **22** has been described.

As previously indicated, the apparatus of the invention may be combined with an exist bar code inventory system. The bar code reader **24** used in conjunction with the invention may be a Scan Gun PSC 5310, sold by Photographic Science Corporation, Webster, N.Y. The bar code wedge **28** may be the Quick Reader™ bar code wedge reader sold by Compsee Corporation, Mount Gilead, N.C. The invention may be used with essentially any computer **30**.

The preferred embodiment of the invention was implemented using the known code of **39** bar code format. The decoder **90** of the mobile transceiver **22** may use standard techniques to convert the bar code digital pulses to the code of **39** bar code format. The invention was implemented using the A034-U-201 bar code decoder sold by Dynasys Corporation, Clearwater, Fla. Any similar Hand Held Laser Code (HHLC) decoder may be used.

The base transceiver **26** and mobile transceiver **22** have been implemented to operate in the 50 to 950 MHz frequency range. The speaker **112** of the mobile transceiver **22** may be substituted with a visual light, an LCD prompt, a synthesized voice prompt, or a vibrating device. In any embodiment, the indicating device is activated by the acknowledge signal.

The mobile transceiver **22** was implemented using a 7.2 V DC battery **70**. The low voltage detector indicator was set to go on at 6.7 V DC.

The foregoing descriptions of specific embodiments of the present invention are presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

I claim:

1. A bar code data exchange apparatus, comprising:

A) a mobile transceiver including:

i. a bar code connector for connection to a bar code reader that generates a set of digital output signals corresponding to bar code markings,

ii. a decoder connected to said bar code connector to convert said set of digital output signals to bar code format signals corresponding to said digital output signals,

iii. a mobile transceiver transmitter connected to said decoder to receive said bar code format signals and transmit wireless bar code signals corresponding to said bar code format signals;

iv. a mobile transceiver receiver, and

v. a mobile transceiver enable circuit to enable said mobile transceiver receiver for a predetermined

period of time after said wireless bar code format signals are transmitted,

B) a base transceiver including:

i. a base transceiver receiver to receive said wireless bar code signals,

ii. a connector connectable between said base transceiver receiver and a bar code interface device to convey said wireless bar code signals to said interface device for transformation into a character set that can be processed subsequently at a computer,

iii. a signal generator to produce an acknowledge signal,

iv. a base transceiver transmitter to transmit during said predetermined time a wireless acknowledge signal corresponding to said acknowledge signal, and

v. a base transceiver enable circuit to activate said signal generator and said transmitter in response to receipt of a valid wireless bar code format signal.

2. The apparatus of claim **1** wherein said mobile transceiver includes:

a battery;

a power regulator connected to said battery; and

a connector power line connected between said power regulator and said bar code connector to provide a power signal to said bar code connector that may be used by said bar code reader.

3. The apparatus of claim **1** wherein said base transceiver includes:

a power regulator; and

an interface device power line connector and said power regulator to carry power received from said connector to said power regulator.

4. A retrofit apparatus to be connected to an existing bar code inventory system of the type that includes a bar code reader to generate a set of digital output signals corresponding to bar code markings, an interface device to transform said digital output signals into corresponding computer data characters, and a computer connected to said interface device to process said computer data characters, the apparatus comprising:

a mobile transceiver connectable to said bar code reader to transmit wireless bar signals, said transceiver including:

i. a decoder to transform said digital output signals from said bar code reader to bar code format signals; and

ii. a mobile transceiver transmitter connected to said decoder to transmit said wireless bar code format signals; and

a base transceiver connected to said interface device to receive said wireless bar code format signals and link them to said interface device.

5. The apparatus of claim **4** wherein said mobile transceiver includes:

a mobile transceiver receiver; and

a mobile transceiver enable circuit to enable said mobile transceiver receiver for a predetermined period of time after said wireless bar code signals are transmitted.

6. The apparatus of claim **5** wherein said base transceiver includes:

a base transceiver receiver to receive said wireless bar code signals;

a signal generator to produce an acknowledge signal;

a base transceiver transmitter to transmit a wireless acknowledge signal during said predetermined period of time; and

a base transceiver enable circuit to activate said signal generator and said transmitter upon receipt of a valid wireless bar code signal.

7. The apparatus of claim **4** wherein said base transceiver includes:

an interface device for connection to said bar code wedge;

a power regulator; and

an interface device power line connected between said interface device and said power regulator to deliver power from said interface device to said power regulator.

8. The apparatus of claim **4** wherein said mobile transceiver includes:

a bar code connector for connection to said bar code reader;

a battery;

a power regulator connected to said battery; and

a connector power line connected between said power regulator and said bar code connector to provide a power signal to said bar code connector that may be used by said bar code reader.

9. A method of wirelessly exchanging data in a bar code inventory system of the type that includes a bar code reader to generate a set of digital output signals corresponding to bar code markings, an interface device to transform said digital output signals into corresponding computer data characters, and a computer connected to said interface device to process said computer data characters, the method comprising the steps of:

converting said digital output signals from said bar code reader into wireless bar code format signals;

transmitting said wireless bar code format signals from a mobile transceiver connected to said bar code reader;

enabling a receiver of said mobile transceiver for a predetermined period of time after said transmitting step;

receiving said wireless bar code format signals at a base transceiver;

transmitting a wireless acknowledge signal from said base transceiver upon receipt of said wireless bar code format signals; and

receiving said wireless acknowledge signal at said mobile transceiver during said predetermined period.

10. The method of claim **9** further comprising the step of powering said bar code reader with said mobile transceiver.

11. The method of claim **9** further comprising the step of powering said base transceiver with said interface device.

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